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RESEARCH REPORT

DESIGN OF AN OVERVIEW SYSTEM FOR EVALUATING THE PUBLIC-HEALTH HAZARDS OF CHEMICALS IN THE ENVIRONMENT

Volume II. The Overview System

to

THE UNITED STATES PUBLIC HEALTH SERVICE

July 18, 1967

BATTELLE MEMORIAL INSTITUTE

COLUMBUS LABORATORIES

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FINAL REPORT

on

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PREFACE TO VOLUME II

Volume II contains a description of the recommended Overview System. Reference herein is made to Volume I, the Test-Case Experiences, which contains a review of potential environmental hazards due to utilization of mercury, nickel, vanadium, and fluorocarbon compounds and the chemicals used by the pulp and paper industry. Volume I provides the detailed information analyses exercises which form the basis of the Overview System described herein.

TABLE OF CONTENTS

	Page
INTRODUCTION	1
SUMMARY	2
RECOMMENDATIONS	5
SYSTEM DESIGN STUDY	6
The Use of Case Studies	6
Mercury	6
Additional Environmental Case Studies	7
Critical Indicators	8
The Overview Literature	9
Scope of Competence for the Recommended Overview Center	9
Chemicals of Public-Health Significance	10
The Thalidomide Experience	11
Time Constraints	11
Start-Up Time	14
Short-Term Threats	14
Long-Term Accumulative Threats	14
THE ENVIRONMENTAL HEALTH OVERVIEW CENTER	15
Relationship of the Overview Center to the Environmental Health Community	15
The Management Organization	17
Project Management	19
Scientific Evaluation and Threat Identification	19
Information Support Operations	19
Consultant Coordination	19
Research and Evaluation Team	19
THE OVERVIEW ALERT SYSTEM	22
The Alert Evaluation Sequence	22
Information Evaluation	22
Evaluation for ALERT A Information	22
United States Public Health Service Evaluation and Authorization	23
Evaluation Reports	23
Information Support Operations	25
Information Storage and Retrieval System	25
ENVIRONMENTAL HEALTH INFORMATION SOURCES	28
Environmental Monitoring Systems	28
Centers of Environmental Health Information	28
Published Literature	30
Estimation of Information Input	31

TABLE OF CONTENTS
(Continued)

	Page
COST ESTIMATES OF AN ENVIRONMENTAL HEALTH OVERVIEW CENTER	33
Discussion	33
Apparent Threat Evaluation Reports	34
Information and Data-Base Activities	34
Scientific Inquiries	35
Cost Analysis	35
SPACE REQUIREMENTS	37
RECOMMENDED PILOT OPERATION	38
REFERENCES	40
APPENDIX A	
SELECTED ENVIRONMENTAL MONITORING SYSTEMS	A-1
APPENDIX B	
NEWSLETTERS, PERIODICALS, AND OTHER PUBLICATIONS PERTINENT TO THE OVERVIEW PROGRAM	B-1
APPENDIX C	
LIST OF CHEMICALS IDENTIFIED IN THE SUBJECT INDEXES OF INDUSTRIAL HYGIENE DIGEST, 1964, AND PUBLIC HEALTH ENGINEERING ABSTRACTS, 1965	C-1
APPENDIX D	
CENTERS OF INFORMATION OF VALUE TO THE ENVIRONMENTAL HEALTH OVERVIEW CENTER	D-1
APPENDIX E	
VISITATIONS TO INFORMATION CENTERS ON TOXICOLOGY	E-1
APPENDIX F	
COST ANALYSES FOR THE FUNCTIONS ASSOCIATED WITH THE ENVIRONMENTAL HEALTH OVERVIEW CENTER	F-1
APPENDIX G	
ACKNOWLEDGMENTS	G-1

INTRODUCTION

The United States Public Health Service, Office of Environmental Health, conceived this project to develop a mechanism for evaluating existing information and reducing it to manageable proportions and forms which would enable it to better carry out its responsibilities in research and control programs. The needed mechanism was considered to be a system which would provide an overview and identification of those activities which might lead to public-health hazards. A system design study verified this concept utilizing an overview information center to provide the necessary hazards-identification, evaluation, and alerting system.

SUMMARY

The need for "an early warning system" or "overview of environmental contaminants" has been expressed recently by members of Congress and various committees studying environmental health problems. However, the Bureau of Disease Prevention and Environmental Control recognized this need over a year ago when it initiated, with Battelle-Columbus, the design for an overview system that would assist in maintaining a continuous surveillance of chemical contaminants in the environment. The needs for such a system are many. The continued and rapid growth of industrial use and production of chemicals poses uncertain risks and hazards to the general public. In addition, there exists a critical need for evaluating the state of knowledge of the interaction of chemicals with man's environment to predict significant and hazardous conditions, as well as changes in future levels of contamination from the presently available state of knowledge. The extent and degree of these hazards are largely unknown. The data that are derived from such a system will also be helpful to the Bureau in establishing priorities for intramural and extramural research and training programs and in the setting of standards and controls and initiation of control measures.

To assess properly the difficulties and problems that would confront a surveillance program, as well as to provide data on the operation of such a system, five specific chemicals or groups of industry were selected mutually by the Battelle investigating team and the United States Public Health Service. These five, including mercury, nickel, vanadium, fluorocarbons, and the chemicals involved with the pulp and paper industry, were treated as urgent surveillance problems.

The results of the case studies were derived from data collected by Battelle staff during travel and discussion with key scientists in specific disciplines, interviews with appropriate staff members of governmental agencies, and analysis of operations of existing and contemplated information centers and of existing governmental and private laboratories engaged predominantly in environmental-health activities. In addition, Battelle's information analysis staff utilized available information sources, including those referred to above, for its analysis of the literature dealing with specific tasks.

The studies revealed potentially hazardous situations. For example, the report on mercury showed a substantial increase in recent quantities of mercury used in the electrolytic production of chlorine. Significant quantities of mercury are released to the environment each year which apparently cannot be traced and which to date cannot be accounted for. There exists a striking lack of fundamental information on national levels of mercury in our air, water, and food.

The study of vanadium showed a significantly increased usage of volatile compounds of vanadium in industrial applications.

The nickel study raised the question of possible chronic effects of small quantities of nickel in food from the use of large quantities of nickel equipment in food processing and the demonstrated transfer of some nickel to food during processing.

A need was demonstrated for the establishment of the environmental fate of fluorocarbons used in aerosols and refrigerants and for the toxicological characteristics of combustion products of fluoroplastics.

Finally, a review of current analysis information on the chemical processes employed by the pulp and paper industry demonstrated the need for surveillance of the atmospheric pollutants resulting from increased use of kraft pulping operations, for toxicological data on paper modified with additives, and for the identification of combustion products of paper and paperboard fortified with additives currently in use.

Through experience developed in dealing with these groups of potential contaminants, information needs were found to fall into predictable categories:

(1) Chemical production

(2) Secondary-product formulation

(3) Pattern of chemical usage

(4) Chemical toxicology and pharmacology

(5) Environmental health hazards.

Based on experience derived from these studies and from the national resources available in information, skills, and competencies to this program, Battelle has designed a system of continuous surveillance of chemical threats to environmental health.

Four separate features were recognized as essential to an Overview Center to provide the necessary functions defined by a surveillance and early alarm role:

(1) It must possess a good scientific library and information-handling capabilities and professional and clerical staff knowledgeable and experienced in information-analysis methods.

(2) It must possess ready and convenient access to a sufficiently large pool of scientific competence to facilitate the rapid preparation of responses to specific queries.

(3) An organizational solution must be presented for the integration of the widely scattered and often unrelated pockets of information and competencies residing in federal, state, and local agencies and with the individual scientists whether in the academic, private, or governmental sectors of environmental-health research.

(4) It must possess to a strong degree the characteristics of immediacy combined with the ability to tap the required skills whenever necessary, to marshal appropriate skills to the level demanded by the urgency of the current problem, and to deliver in-depth competence on demand. This requires the managerial ability to fuse all the required functions necessary for an Overview Center into a viable, functional operation, focused strictly upon its mission-oriented objectives.

It was found that 70 percent, or more, of the desired information relative to changes in the level of contamination of our environment by chemicals (together with relevant information from the fields of ecology, physiology, toxicology, and public health) could be obtained from a preliminary surveillance of 61 key publications and 12 industrial and governmental contacts. It is estimated that this preliminary surveillance

(including information acquisition and processing and technical surveillance) will require 27 professional man-months. Approximately 38 professional man-months of effort would then be required to identify and evaluate "hot" leads on possible threats to public health due to chemicals in the environment. It was estimated that up to 24 in-depth case studies per year (involving approximately 85 man-months of effort) of critical hazards should be undertaken in the overview program. The total program for a comprehensive overview of chemical threats to environmental health is judged to require 187 professional man-months of effort plus consultant assistance. This total includes project management and information support activities in addition to those mentioned above.

Battelle recommends, therefore, that an Overview Center be established within an existing institutional structure possessing the qualifications necessary to provide both the information-analysis specialities and a significant multidisciplinary block of professional scientists to immediately provide an internal core for such a Center.

An office, established and staffed by personnel of the Bureau of Disease Prevention and Environmental Control, would provide continuous and intimate relationship to the Overview Center, permit the Bureau staff to immediately establish information and research priorities, and establish and maintain an integrated national network of skills and expertise which could participate both in the evaluation of potential threats to human health and in contributing research efforts toward their solution.

The report identifies the necessary components of the Center itself, as well as specific recommendations for the Bureau of Disease Prevention and Environmental Control's participation in the integration of appropriate skills and resources into the Overview Center.

Finally, the report deals with the requirements, costs, and recommended methods of operation of the total Overview Program, following the successful completion of the period of preliminary pilot phase of the recommended operation. A continuation of the present program at Battelle would provide access to Battelle staff in the initiation of the final Center following the pilot phase already defined.

RECOMMENDATIONS

As a result of this study Battelle recommends:

(1) The Bureau of Disease Prevention and Environmental Control establish an office that would be responsible for:

   (a) Surveillance of environmental hazards

   (b) Studies of hazards

   (c) Recommendations concerning areas of research

   (d) Recommendations on quality standards control

(2) The Bur[illegible]u of Disease Prevention and Environmental Control establish an Over[illegible]w Center that would provide the basic information to meet the objective of the office above

(3) The Bureau of Disease Prevention and Environmental Control implement this program through a pilot program at Battelle's Columbus Laboratories as outlined in this report.

It is further recommended that this design for an Overview Center be implemented by the creation of a limited-scope Overview Center on a pilot basis, with carefully circumscribed tasks over an 18-month period. This would permit the testing of the design of the surveillance-alert system to be undertaken and the introduction of modifications and improvements prior to initiation of a wide-scope Overview Center. This preliminary period would be used effectively for the careful assembly of the component parts necessary to the establishment of the final Center. An 18-month, limited-scope, pilot model of the Overview Center could selectively identify a limited scope of operation across all phases of industrial chemical interaction with the environment, or it could select an in-depth surveillance of a limited segment of industrial production. These alternatives, and the advantages of each, are examined in the report.

The basis for these recommendations and the specific actions and tasks necessary to implement such a program are presented in detail within the body of this report and the accompanying appendices.

SYSTEM DESIGN STUDY

To design a system to maintain an overview of the public-health hazards of chemicals in the environment, the Battelle staff analyzed the nature of the questions which scientific evaluators might have to consider in maintaining an overview of the environment. The following are representative of some of the more important questions:

> What chemicals are of economic importance? In what quantities are they produced? Where are they used? Are they toxic? . . . in what amounts? . . . under what conditions? Does a given chemical present a potential public-health hazard? Is this hazard recognized? What changes are taking place in total production? . . . in relative use patterns? . . . as new uses? Of what consequences are these changes to public health? Are there changes in per capita consumption of toxic materials? Are toxic materials accumulating in the environment? Are relatively harmless materials being replaced by more toxic materials?

The broad nature of the overview considerations and the depth of knowledge required to properly evaluate possible threats to the environment are immediately evident. Given sufficient time and effort, it would be possible to answer most of the questions posed above for each material of interest. However, in view of the many materials that should be considered and the broad scope of the information required to answer such questions, it was considered mandatory to identify those factors most critical in determining or rating a possible threat. The identification of these factors would, in turn, reduce the total amount of information and data over which surveillance would have to be maintained.

The Use of Case Studies

To determine those factors critical to an overview of the environment, several case studies were undertaken. These studies were chosen to represent a wide variety of chemical materials already recognized as potential threats to public health. Each study was initiated to expose differences in the nature and criticality of those factors necessary in considering a possible chemical threat. Thus, variations in the availability of information and other possible factors of importance in designing an effective system could be identified. By agreement between Battelle and the Public Health Service, mercury, including its several compounds, was selected as the subject of the first case study. The full case study is presented in "Volume I. Test-Case Experiences" of this report and is summarized below.

Mercury

A chemist, a biochemist, and an information scientist were assigned to the project. Each of these workers in his previous experience had devoted a major share of his research effort to analysis projects fundamentally similar in scope and complexity to those of the present project.

The research team determined that the basic information needs were data on the production, utilization, and ultimate disposal of mercury materials. The study took mercury as prepared at the mine; determined the share going into the several major use categories; identified the important secondary formulations which were actually applied; followed their fate in soil, water, and air; and, finally, evaluated the significance of their interaction with man as they move through the environment toward ultimate disposal.

Sources of information necessary to begin quantification of mercury production, its utilization, and its disposal were located and identified. Each source was further evaluated as to its potential value in the surveillance of other materials of possible concern to the overview system.

The crucial facet of the case study on mercury was to determine the investigation team's ability to identify a possible threat to the public health and to determine the means by which this could be accomplished. In this instance the team identified the following analysis as being illustrative of one method by which a threat could be recognized and evaluated:

> Based on Bureau of Mines data, 8700 flasks* of mercury were used in 1965 in the electrolytic production of chlorine; in 1966 10,300 flasks were used. Since each ton of chlorine production consumes about 0.4 pound of mercury, about 16,000 flasks could be consumed annually by 1970 in the electrolytic production of chlorine. Their data also indicated that the mercury required to charge new mercury cells through 1970 will be between 47,000 and 60,000 flasks. These increases in usage and the consumption serve as possible sources of contamination.

Additional Environmental Case Studies

In the second phase of study, nickel, vanadium, fluorocarbons, and pulp and paper chemicals were selected as subjects of follow-on studies to test and refine the design which had been developed to meet the information and analysis needs relative to maintaining an overview of the health hazards of mercury.

As in the mercury study, considerable attention was given to the method by which the nature of a threat was identified. The logic followed in the study of the pulp and paper industry is given below:

> Based on Gaylor's Technical Survey, and in more detail on The Statistics of Paper, 1966 Supplement - American Paper Institute, chemicals for pulp manufacture, chemicals for pulp bleaching, and notably chemicals used in paper and paperboard manufacture continue to show sharp increases. These can lead to air pollutants consisting of solid emissions, odorous gases, and mists. Particularly obnoxious are odorous gases consisting of sulfur dioxide, hydrogen sulfide, methyl mercaptan, dimethyl sulfide, and dimethyl disulfide. Most of these are associated with the kraft pulping process which is scheduled to rise from a 1955 output of 11.6 million short tons to 32 million short tons by 1975.

*A flask = 76 pounds.

In spite of 98 percent efficiency in reduction of odors, an average plant still discharges daily approximately 70 pounds of methyl mercaptan and 50 pounds of methyl sulfide. Thus, with a threefold increase of useful output, these plants will provide a corresponding increase in hazardous chemicals.

Critical Indicators

The scientific evaluators were asked to define those critical indicators (both information and data) by which they could maintain surveillance of the five materials considered in the case studies. Particular emphasis was placed upon the rapid evaluation of possible threats to the environment from these materials as contaminants.

Table 1 is a composite list of the critical indicators divided into five major categories. In addition to their role as critical indicators these terms could also serve as guides for identifying current literature and other communications of direct concern to the Overview Center.

TABLE 1. LIST OF CRITICAL INDICATORS

(1) Environmental contamination
- (a) Geographical distribution
- (b) Distribution between soil, water, air, and life
- (c) Biogeochemical cycle of major formulations

(2) Toxicological manifestations
- (a) Physiological interaction with man
- (b) Toxicity level
- (c) Symptomatology
- (d) Epidemiology

(3) Primary production
- (a) Description of processes
- (b) Number and location of plants
- (c) Annual production records
- (d) Distribution by use categories

(4) Secondary-product formulation
- (a) Description of processes
- (b) Number and location of plants
- (c) Capacities and production by end product

(5) End-product distribution and use
- (a) Historical records
- (b) Current annual use data
- (c) Identity and properties of most important formulations
- (d) Industry forecasts

The Overview Literature

Based upon the case studies and the Critical Indicators, it was found that a limited, well-defined corpus of literature would permit a comprehensive surveillance of the contamination of man's environment by chemicals. This list of publications is listed in Appendix B in the section entitled "Chemistry and Industry".

On the other hand, the areas of ecological and toxicological information and the reporting of new pharmacological and biochemical discoveries of possible importance to the overview system are not so amenable to surveillance. In Table 1, these areas are represented by the critical indicators listed under (1), environmental contamination, and (2), toxicological manifestation.

It has been found virtually impossible to identify and segregate a limited body of primary journals that would permit an adequate overview of these areas to be maintained. New information and data in these areas of the overview concern are diffused through English and foreign-language publications. This means that if the Overview Center is to be alert to these events, a broader coverage of United States and world literature and greater reliance on abstracting services should be maintained than is necessary for "Chemistry and Industry". Accordingly, the research team developed a limited list of source materials that would permit a reasonable surveillance to be maintained. This final selection is represented by the remaining six sections of Appendix B.

Appendix B, then, represents a minimal list of publications to be screened in an effort to provide a high degree of coverage of the world literature as related to overview concerns. Fourteen principal abstract journals have been included to permit surveillance of the world literature. In addition, applicable news letters have been included in this list.

It is estimated that this list of journals, abstracts, and information sources should permit coverage of 70 percent or more of the desired information at a reasonable cost.

Scope of Competence for the Recommended Overview Center

It was established mutually by the Public Health Service and Battelle early in the contract period that the system would provide coverage of chemical materials as opposed to biological materials. Also excepted were radiochemicals and their effects.

For convenience in following statistical data on chemical materials, the chemical materials have been subdivided into 15 major categories. These categories, shown in Table 2, were chosen because they closely match the production and consumption statistics published in Inorganic Chemicals and Gases (U.S. Dept. Commerce), Minerals Yearbook (U.S. Bureau of Mines), and Synthetic Organic Chemicals (U.S. Tariff Commission), the three major published sources of such statistics. It is estimated that these sources represent approximately 7500 materials, many of which may be of possible interest.

The next step was to attempt to estimate the number of materials within the 15 categories most likely to be of immediate concern to the Overview System. In the final

analysis this is a variable factor dependent on the condition of the environment and the contaminants being expelled into it at any given time.

TABLE 2. MAJOR CATEGORIES OF MATERIALS OF CONCERN TO THE OVERVIEW SYSTEM

Chemical Feedstocks from Petroleum, Natural Gas, and Coal
Cyclic Chemical Intermediates
Dyes
Flavor and Perfume Chemicals
Inorganic Chemicals, n.e.c.(a)
Medicinal Chemicals
Metals (except alkali) and Their Compounds
Nonmetallic Minerals and Fuels
Organic Chemicals, n.e.c.(a)
Pesticides (and other agricultural chemicals)
Plasticizers
Plastics and Resins
Rubber Processing Chemicals
Surface-Active Agents
Synthetic Rubber (elastomers)

(a) n.e.c. = not elsewhere classified.

Chemicals of Public-Health Significance

One way of determining the number of materials of current concern to environmental-health specialists would be through a direct survey. This would have represented a costly and time-consuming operation. However, through the use of the latest available indexes to abstract journals, it was possible to identify materials causing concern as expressed in the primary journal literature.

The 1964 subject index of Industrial Hygiene Digest, and the 1965 subject index of Public Health Engineering Abstracts were assumed to represent, in part, a compilation of those chemical terms related to materials of significance to environmental public health. Names of elements, compounds, and a few broader terms appearing in these indexes were selected and the number of citations for each was tallied. Other entries such as the use of chemicals for insect control or water treatment were omitted except where there was an established adverse public-health aspect.

The results of this analysis are tabulated in Appendix C according to the major categories previously discussed. From this analysis 286 chemicals were recognized during the period 1964-65 as being potential hazards and, therefore, of possible concern to the Overview Center. Obviously, this list will need to be updated and refined by the Center, and it is probable that additional chemicals and materials of concern may be identified.

Further analysis of the frequency of the number of times a given compound was cited in the literature is shown in Figure 1. It can be noted that a number of chemicals were cited 20, 30, 40, or more times. Some specific examples are coal and coke, cited 39 times; pesticides, 42 times; carbon monoxide, 44 times; lead, 57 times; and sulfur oxides, 94 times. These are chemicals of very urgent public-health significance at the present time.

At the other extreme, 227 chemicals in this sample were cited five or less times. One is tempted to say that these are of no importance in the overview system; that attention should be concentrated on the frequently cited chemicals of obvious and urgent public-health importance.

However, at the same time, the single citation or newsletter item may be the first alert to a major threat to the public health. For this reason, it was decided to examine a typical case study, that of thalidomide, which represented, in a sense, a fast-breaking, immediate threat to the public health.

The Thalidomide Experience

Thalidomide is a classic example of an economically important compound which introduced a severe threat to public health. An annotation in The Lancet, September 12, 1964, provides a concise summary of the thalidomide experience in the United Kingdom.

> Thalidomide, a non-barbiturate hypnotic synthesized in Germany in 1956, became available in the United Kingdom in 1958. In November, 1961, Dr. W. Lenz of Hamburg, reported that this drug apparently had teratogenic effects when administered to women early in pregnancy; and the drug was withdrawn from the British market on December 2, 1961.

A report of the British Ministry of Health[1]* estimated that between 200 and 250 children were born and survived in Britain with thalidomide-induced deformities. In Figure 2 the critical events of synthesis, market introduction, hazard recognition, and market removal of thalidomide are shown on a chart depicting the number of technical publications on thalidomide and possibly related teratogenic effects in the period 1956-1964, inclusive[2]. As indicated in the figure, only a small number of relevant items appeared in the technical press prior to the introduction of thalidomide. The number of relevant items increased dramatically during the 3 plus years in which the drug was in use. About a hundred pertinent items had been published by the time the drug was withdrawn from the market. In the following 3 years the number of published items was in excess of 500. These articles verified the side effects of the drug. This example illustrates the necessity for early identification and evaluation of environmental health threats if extensive ill effects are to be avoided.

Time Constraints

It is necessary to consider time constraints on the overview system from several distinct, yet interrelated points of view. These are as follows:

(1) Start-up time

*References are given on page 40

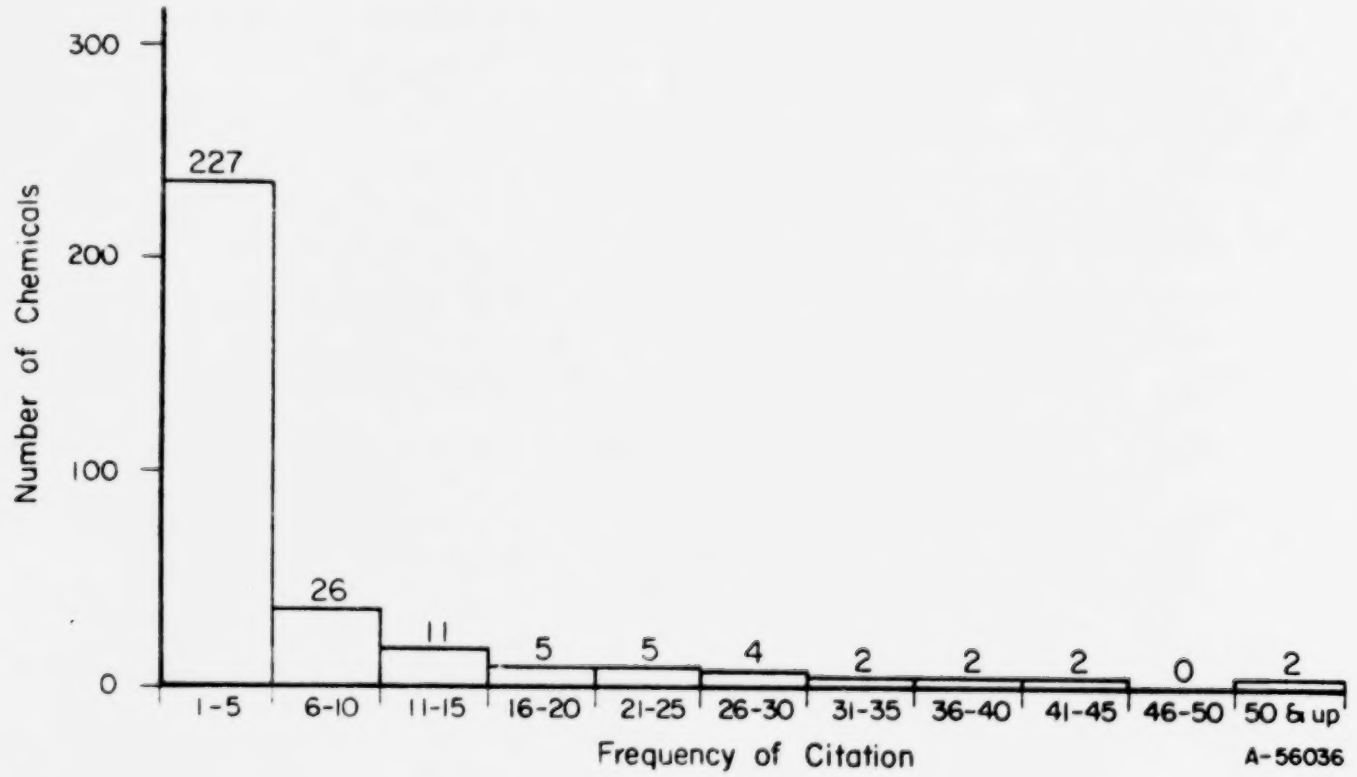

FIGURE 1. FREQUENCY OF CITATION FOR A GROUP OF 286 CHEMICALS MENTIONED IN A SAMPLE OF RECENT PUBLIC-HEALTH LITERATURE

(1964 Industrial Hygiene Digest and 1965 Public Health Engineering Abstracts)

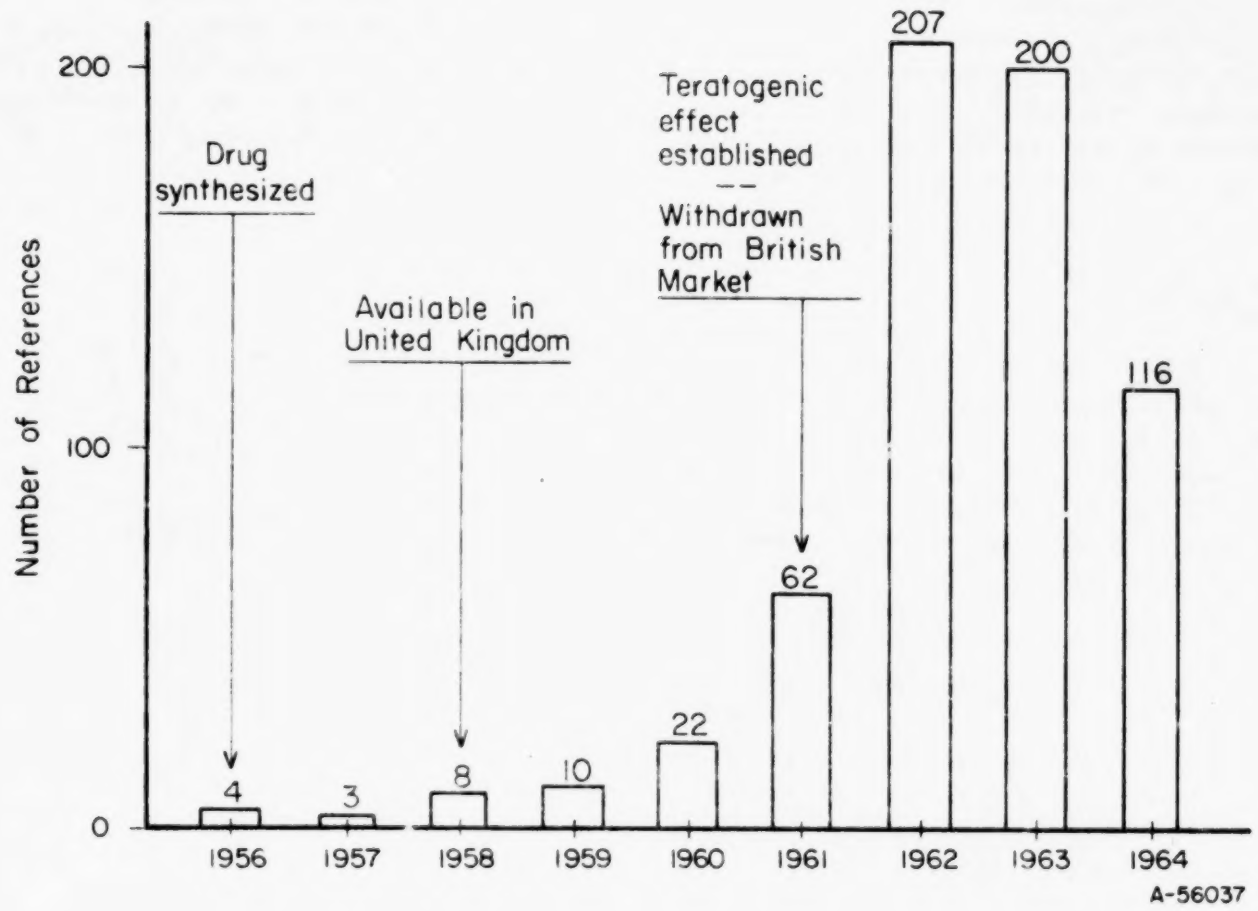

FIGURE 2. NUMBER OF REFERENCES TO THALIDOMIDE AND TERATOGENIC EFFECTS RELATED TO THALIDOMIDE USE, 1956 - 1964, INCLUSIVE[2]

(2) Short-term threats to the environment

(3) Long-term accumulative threats to the environment.

Start-Up Time

As previously pointed out, the environment is under threat now by various contaminants being introduced into the atmosphere, our water supply, and our food chain. New materials, new manufacturing processes, and new agricultural uses of chemical derivatives are all potential threats to the environment.

One of the requirements for the Overview Center, then, is that it be capable of becoming operational, at least in the more critical areas, as quickly as possible. It is the recommendation of this investigation team that the system be so designed as to permit preliminary evaluation and response within 3 to 6 months from the date of start-up. Expansion thereafter to a fully operational system would depend on various administrative factors such as rate of effort and financing.

Short-Term Threats

The introduction of a new, toxic material into the environment can create a considerable health hazard to man in a short period of time. Public reaction to such contamination can be quick and strong, particularly in view of the mass-communication media. Therefore, the Overview Center should be capable of quickly accessing potential sources of contaminants and their possible effects in man's environment. It is the recommendation of this team that the reaction time of the Overview Center must be quick and specific.

Long-Term Accumulative Threats

Some contaminants may pose no immediate threat to the environment. Or, in some instances, it may be impossible to identify a threat though conditions may warrant close surveillance. The Overview Center should provide for the periodic monitoring of the literature of such contaminants, based on the judgment of qualified scientific evaluators.

THE ENVIRONMENTAL HEALTH OVERVIEW CENTER

In view of the wide variety of potential contaminants and the many factors which must be considered for each material that may pose a threat to man's environment, a large knowledgeable staff of experts possessing a diversity of skills will be required to maintain a proper overview. Based on both the case studies and a projection for the chemicals and material classes of possible importance to the Overview Center, as previously discussed, a partial list of the possible skills required to maintain a total overview is presented in Table 3. Such a staff of experts would be very cumbersome and costly to maintain solely for the overview system. Aside from a core group representing six or seven fields of science or technology, most of the specialties listed in Table 3 would be required for rather limited periods of time at unpredictable interview. The problem is one of having these talents available on call but otherwise gainfully employed when not in demand for the performance of overview functions.

TABLE 3. PARTIAL LIST OF INTERDISCIPLINARY SKILLS THAT MAY BE REQUIRED BY AN OVERVIEW SYSTEM

Agriculture	Medicine
Analytical Chemistry	Metallurgy
Area Economics	Meteorology
Biochemistry	Microbiology
Biophysics	Organic Chemistry
Catalysis and Surface Chemistry	Organic Coatings
Ceramics	Pathology
Chemical Engineering	Petroleum Chemistry
Earth Atmosphere Sciences	Pharmaceutical Chemistry
Ecology	Pharmacology
Economics	Physical Chemistry
Electrochemistry	Physics
Electronics	Physiology
Environmental Biology	Plant Sciences
Environmental Mechanics	Pulp and Paper Technology
Food Science and Technology	Rubber and Plastics
General Chemistry	Socio-Economics
Inorganic Chemistry	Systems Analysis
Lubricant Technology	Textiles Technology
Manpower and Regional Economics	Transportation
Marine Biology	Veterinary Science
Materials Engineering	Wood Technology
Mechanical Engineering	

Relationship of the Overview Center to the Environmental Health Community

Figure 3 shows the proposed relationship of the Environmental Health Overview Center to the United States Public Health Service and to the environmental-health community at large. A direct communication tie should be maintained between

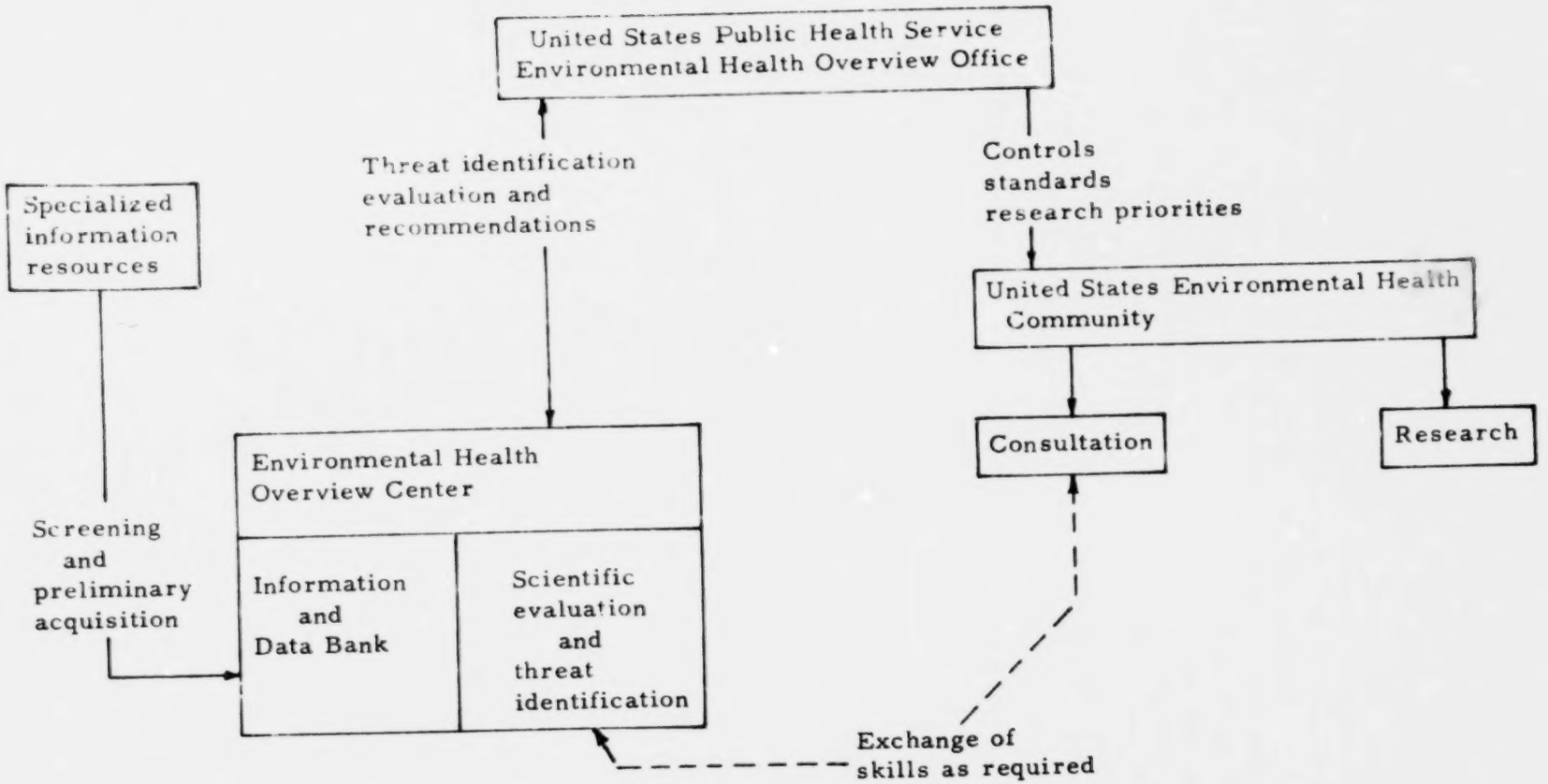

FIGURE 3. RELATIONSHIP OF ENVIRONMENTAL HEALTH OVERVIEW CENTER TO THE UNITED STATES PUBLIC HEALTH SERVICE AND THE ENVIRONMENTAL HEALTH COMMUNITY

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the Environmental Health Overview Office, United States Public Health Service, and the Center. Reports of threat identification, evaluation of possible threats, and recommendations would permit close liaison to be maintained between the two facilities. Further, as a result of overview and research activities of the scientific evaluators, it would be possible to answer inquiries from the environmental-health community.

Whenever desirable, the Center, with the approval of the United States Public Health Service would utilize the assistance of the many specialists which exist throughout the Federal Government as well as the industrial and educational communities. The assistance provided by such specialists can be compensated for by the assistance which the Center may be able to render in turn to them.

It is important to emphasize the interrelationship and interdependence of these segments of the total community. Much can be gained through the development of cooperative relationships and communication between these focal points of the total community in increased awareness of possible threats to the public health and in reducing the reaction time once such a threat begins to occur.

With the above thoughts in mind, it appears highly desirable that the Environmental Health Overview Center maintain a subcenter in the Washington, D. C., area. This subcenter should operate as a focal point for liaison with Public Health Service and other government activities and centers of environmental health research which are centered in Maryland, Virginia, and Washington, D. C., areas.

The Management Organization

A number of staff organizational plans are possible depending on the nature of the management environment in which the Overview Center is developed and operated. The most effective structure is considered to be one in which the Overview Center can function as an adjunct to a large parent institution which performs high-quality research in many fields of interest. Thus, the Public Health Service might develop the overview operations either as a satellite of a major service laboratory or as a contract operation within a large private research organization. In any case, the broad scientific and technical staff capabilities previously described should be present within the parent institution and, most importantly, be readily available to the overview operation.

The utilization of a large laboratory or research organization has the advantage in that it will directly involve a substantial staff of diverse research-oriented talent in the environmental-health problem. This talent can be readily available to perform such research as might be necessary to answer specific questions as may arise from time to time in evaluating specific threats to the environment.

A suggested management staff for the Overview Center is shown in Figure 4. This management core is designed to utilize an interdisciplinary staff, consultants, and a data bank. It is also designed to permit expansion or reduction of both the management staff and the support staff in accordance with the demands placed upon the Center.

A fully operational Center probably will require a management staff of four professionals to coordinate and administer the overview system plus necessary clerical and support personnel. The functions of this staff are described in detail below:

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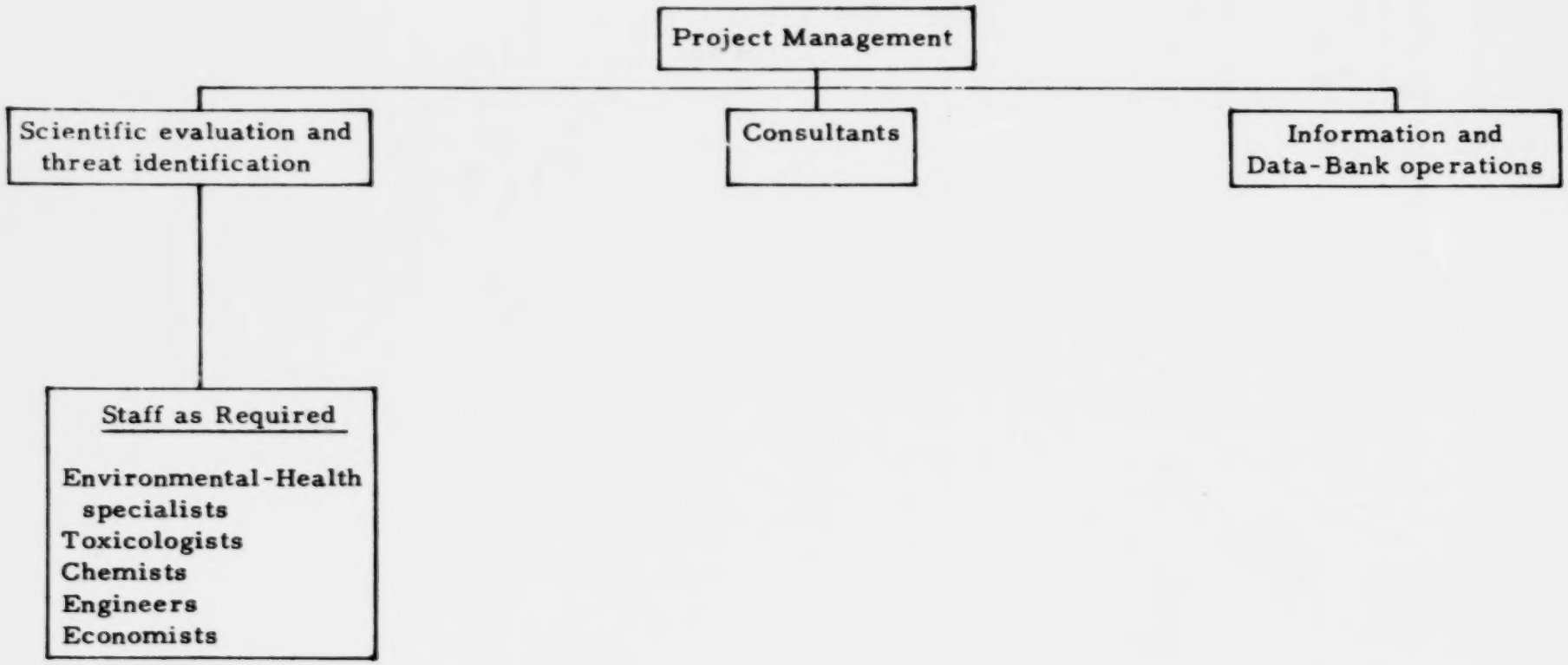

FIGURE 4. MANAGEMENT STRUCTURE OF ENVIRONMENTAL HEALTH OVERVIEW CENTER

Project Management

The overall responsibility for the Overview Center includes management of the Center, liaison with the Public Health Service, and fiscal and quality control.

Scientific Evaluation and Threat Identification

Establishment of proper work relationships to fit the Overview Center into the program activities of the parent organization assuring completion of evaluation and threat-identification tasks.

Information Support Operations

Provides all necessary support to scientific evaluators, consultants, and operates the storage and retrieval system in connection with the information/data bank.

Consultant Coordination

Secures full utilization of specialist skills as necessary from industry, educational institutions, and the Federal Government. Maintains cognizance of monitoring systems, information resources, and research pertinent to the overview system.

Research and Evaluation Team

Provide scientific evaluation, within their fields of specialization as indicated in Table 3, of assigned situations in environmental health. Identify areas of potential threat to the public health and recommend appropriate follow-on action.

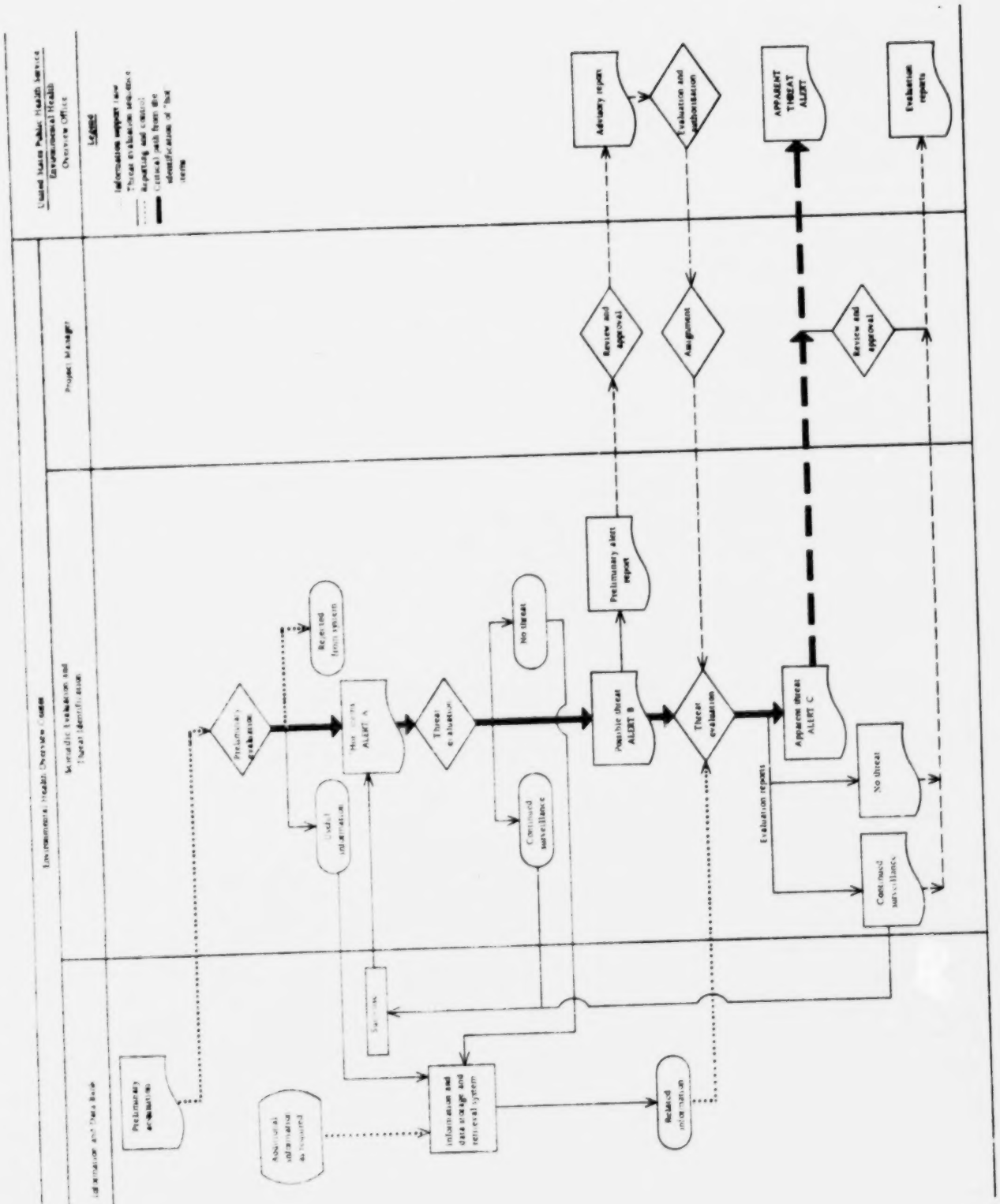

FIGURE 5. FLOW OF INFORMATION AND EVALUATION TO ANALYZE A POTENTIAL THREAT

ENVIRONMENTAL HEALTH
OVERVIEW SYSTEM

Information Evaluation

Prepared by _____ Date _____

Citation: _____

_____

_____

Comments on Important Aspects: _____

_____

_____

_____

EVALUATION:

☐ Worthy of Evaluation. ALERT A

☐ Of concern: Hold in Data Bank.

☐ Of no interest to Overview. Discard.

FIGURE 6. FORM TO BE USED TO TAG IDENTIFIED INFORMATION FOR EVALUATION

THE OVERVIEW ALERT SYSTEM

The alerting system centers around three levels of alerts, each representing an increasingly positive identification of a potential threat to man's environment. The alerting sequence is discussed in detail in the following sections.

Figure 5 presents in detail the flow of information through the three progressive levels of threat identification. In this chart the dotted line represents the flow of selected relevant information; the solid line represents the threat-evaluation sequence, and the dashed line represents reporting and control. The heavy solid line represents the critical path from the identification of a "hot" item which upon preliminary study appears to be worthy of further evaluation to the identification of an apparent threat (Alert C). The heavy dashed line, in turn, represents the transmittal of APPARENT THREAT ALERT and the evaluation report to the Environmental Health Overview Office.

The Alert Evaluation Sequence

The Alert Evaluation Sequence begins at the time a positive identification of a "hot" item is made whether it be from the literature or from some other form of communication such as correspondence, a telephone conversation, the news media, or a technical meeting.

Once the alert sequence has been established by the recognition of an ALERT A status, the information becomes a matter for evaluation of the possible threat to the public health by one or more of the scientific evaluators previously described in the section on the Environmental Overview Center.

Information Evaluation

An Information Evaluation Form, illustrated in Figure 6, will tag the information for assignment and preliminary evaluation by the scientific evaluator. The evaluator may, in completing this form, declare the information of no value and such information will immediately be discarded from the system. If he judges the information important to the overview, but not of immediate concern, it will be processed directly into the Information and Data Bank. Or, the information may represent a "hot" lead in which case he will declare ALERT A status and hold the item for further evaluation.

Evaluation for ALERT A Information

An "A" alert may be judged on its own merit and in view of knowledge already available to the scientific evaluator. He may seek, also, some confirming data or information from the data bank. It is not intended that such an evaluation would require more than 1 or 2 hours of the evaluator's time. At this point he has a choice of one of four actions, as shown in the flow chart, Figure 5:

(1) He can declare "no threat" and return the information to the data bank for future reference.

(2) He may decide that continued surveillance is necessary and request that this item be called to his attention in some definite period of time.

(3) He may ask for assistance in evaluating the information by a scientific evaluator having other capabilities or knowledge.

(4) He may decide that there is an apparent threat that warrants detailed investigation and assign ALERT B status.

The ALERT A evaluation form is shown in Figure 7. This form must be filled out and returned with the information with an advisory copy to the Project Manager. If he declares a "Possible Threat, ALERT B", the evaluator must prepare a brief summary to accompany the evaluation form to indicate the known details and reasoning surrounding the apparent threat. Further, within the available knowledge at the time, recommendations as to further action to be taken (e g., consult with other specialists or undertake a detailed evaluation) must be indicated on the evaluation form.

United States Public Health Service Evaluation and Authorization

Submission of an Advisory Report based on ALERT A information and additional verification of a potential hazard to the Environmental Health Overview Office of the United States Public Health Service would provide the office with both the necessary intelligence concerning a possible threat to the public health and also an additional point of management control over the activities of the Center. Indeed, it is possible that the Office at this point might be aware of either other research or expertise in the area of the possible threat. On the other hand, a detailed evaluation of the possible threat may be required. Priorities and degrees of urgency may also be indicated at this point.

In any case, at this point, the Environmental Health Overview Office could either authorize an evaluation report or terminate the alert.

Evaluation Reports

Upon receipt of authorization from the Environmental Health Overview Office, the Center should undertake the technical and scientific analysis of the possible threat to determine its true significance to the public health. Normally, such studies would involve activities and analyses similar to those undertaken in the preparation of the five case studies. The evaluation report should be prepared in depth utilizing the full competence of the technical staff available to the Overview Center and, if necessary, such other expertise (consultants) as might be available within the Federal Government, industry, or the educational institutions. Specifically the report would:

(1) Define the threat in depth, and the bases for such evaluations.

(2) Recommend specific actions to be taken or immediate research to be undertaken, to resolve the threat in the most rapid and efficient manner, in the best interests of the public.

ENVIRONMENTAL HEALTH
OVERVIEW SYSTEM

Report of Possible Threat

Prepared by _____ Date _____

EVALUATION:

☐ Possible Threat: ALERT B (Attach explanation)

☐ Suggest further review by _____

☐ Of concern. To be reviewed in _____ months.

☐ No threat apparent. Return to Data Bank.

Nature of Possible Threat: _____

_____

_____

Further Action Recommended: _____

_____

_____

_____

Note: Include locale or geographic area, contaminant, environment, and estimate of threat.

SOURCE INFORMATION

1. Citation or Source: _____

   Summary of Information: _____

   _____

2. Citation or Source: _____

   Summary of Information: _____

   _____

Note: Attach additional sheets as necessary.

Reviewed by: Associate Manager,
Research and Evaluation _____

Manager _____

FIGURE 7. ALERT A EVALUATION FORM

Such an evaluation may (1) declare clear threat, either immediate or long term, (2) restore ALERT A status with a recommendation for continued surveillance, or (3) terminate the alert.

In addition to the Evaluation Report, a summary report form, entitled "Report of Apparent Threat" (see Figure 8) would be filed with the Environmental Health Overview Office. This form is designed to provide a quick summary of the evaluation and of the recommended actions.

Information Support Operations

To provide information and data support to the scientific evaluators, a strong information support program should function as an integral part of the Environmental Health Overview Center as depicted in Figure 5. The functions of the Information Support Operations would include the following assignments.

(1) Monitor primary and secondary literature sources under technical direction for relevant information and data

(2) Perform specialized literature searches under the direction of the scientific evaluators for background information and data necessary for the performance of scientific evaluations

(3) Maintain a roster of research organizations and personnel and information and data sources under the direction of the Project Manager

(4) Interface with various information centers and services for the acquisition of required information and data

(5) Maintain a suspense system of ALERTS B and C reports for subsequent reevaluation by the scientific evaluators

(6) Establish and operate an information/data bank of all information required by the scientific evaluators.

Most of the above task assignments are self explanatory. However, a brief description of the recommended storage and retrieval system for the information/data bank and for the roster of information sources is desirable.

Information Storage and Retrieval System

The state of the art of indexing documents and periodical literature has now progressed to the point where such indexing may be stored on magnetic tape or on disk-pack storage devices. Techniques have been developed permitting Boolean searches of subject indexing. Such searches usually identify the accession numbers of documents likely to contain relevant information. When sufficient storage capacity is available, the product of the search can be document abstracts and citations.

ENVIRONMENTAL HEALTH
OVERVIEW SYSTEM

Report of Apparent Threat

Prepared by _____ Date _____

EVALUATION:

- ☐ Immediate Threat.
- ☐ Long-term Threat.
- ☐ Recommend Continued Surveillance.
- ☐ No Threat Apparent.
- ☐ Suggest Further Review by _____.

Brief Summary of Apparent Threat: _____

_____

_____

_____

_____

Note: Include locale or geographic area, contaminant, and environment. Detailed analysis to be attached.

Recommended Action: _____

_____

☐ Report Attached.

☐ Report to be submitted (by _____)
date

Review by Project Director _____

Submitted to Environmental Health Overview Office, PHS _____

FIGURE 8. APPARENT THREAT REPORT FORM

For large-scale systems, it is possible to place documents on aperture cards, microfilm, or microfiche storage and to relate these documents to the computer search for semiautomatic retrieval.

Most organizations of the type which would be considered for management of the Environmental Health Overview Center have the scientific and technical library, expertise, hardware, and software available for such operations.

However, within the current state of the art, computerized systems represent a considerable investment. The advantages to be gained are questionable, particularly during a pilot operation such as suggested by this study.[3]

It is recommended that the pilot Overview Center remain cognizant of these developments and plan a computerization at such time as economic advantage is offered by such an approach. Further, it is recommended that until full mechanization is achieved the following precautions be observed:

(1) Information system utilized for the pilot-phase operation of the Environmental Health Overview Center should utilize low-cost but efficient manual systems.

(2) All systems should be operated in such a manner as to be compatible with mechanization within the current state of the art.

(3) Adequate vocabulary control be maintained as to permit possible mechanization at a later date. The "Medical and Health Related Sciences Thesaurus"[4] should be followed as closely as possible in all indexing operations.

(4) Use should be made of electronic-data-processing techniques wherever advantages in efficiency or utility warrant such operations.

ENVIRONMENTAL HEALTH INFORMATION SOURCES

As indicated previously, an extensive effort has been made throughout this study to identify and evaluate principal sources of environmental information and data throughout the United States. There are many small sources which are of potential value.[5, 6] However, for the purpose of this study, effort was concentrated on the larger, and perhaps more critical, sources.

The existing sources of environmental-health information divide into three principal categories:

(A) Environmental monitoring systems

(B) Centers of research, development, and information

(C) Published literature.

Figure 9 provides the relationships of the various information and data inputs to the Overview Center.

Environmental Monitoring Systems

Appendix A contains an inventory of the principal sampling networks for air and water contamination. These networks will of necessity play a large role, either directly or indirectly, in the future development of the overview system. Already these systems are sampling some of the pollutants that will be of concern to the Overview Center. As particular emphasis is placed upon various threats to the environment, these networks may be requested to collect or supply critical data.

For example, the National Air Sampling Network is already analyzing air samples for vanadium, the subject of one of the case studies. The Federal Water Pollution Control Administration is analyzing selected station samples for traces of vanadium. From these sources, it may be possible to make an estimate of the amount of vanadium in the environment.

Centers of Environmental Health Information

Many specialized centers which are currently engaged in research or the analysis of data relevant to environmental health are listed in Appendix D. The centers are listed according to area of speciality:

Environmental Health (Human Epidemiology)

Ecology (Epidemiology of Plants and Animals)

Demography (Population Statistics and Research)

Business Economics

Pollution Technology

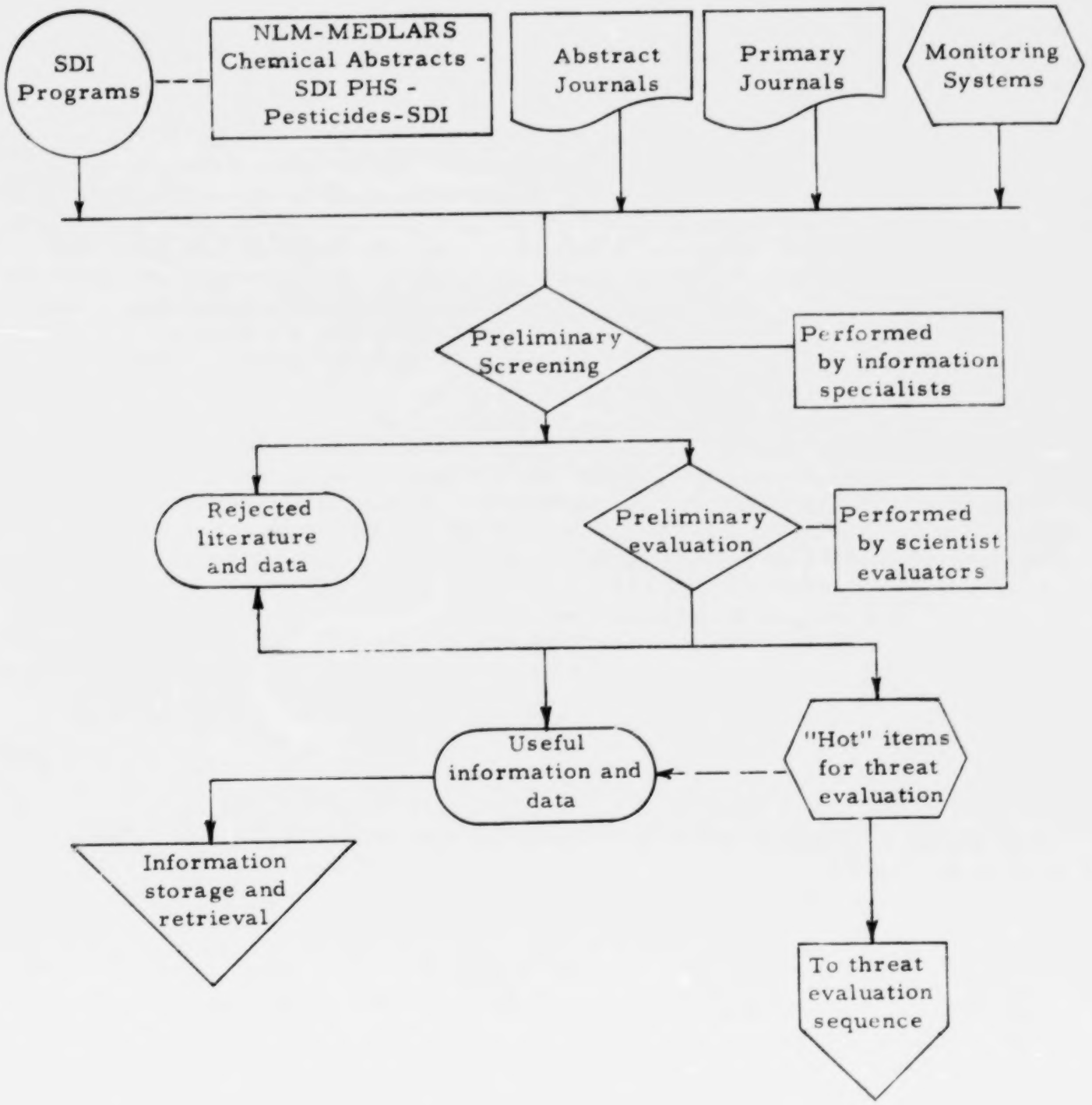

FIGURE 9. INFORMATION AND DATA INPUT SCREENING

Physical Environment (Meteorology, Hydrology, Topography, etc.)

Toxicology

Private centers such as those operated by drug manufacturers are not included in the list due to their limited accessibility.

As a result of a review of selected publications from the information centers (Appendix D) and visits to toxicology centers (Appendix E), the investigating team found that none of the centers listed provided an overview of environmental-health information. For example, the National Clearinghouse for Poison Control Centers (NCPCC) maintains a current file on the acute toxicity of commercial products. Some 25,000 file cards which list trade names, criteria for diagnosis or poisoning, and treatment measures are maintained. The National Library of Medicine, MEDLARS computer searches provide demand bibliographies of biomedical citations. While each of these centers could provide an input to the Environmental Health Overview Center, they are unable by themselves to fill the need for an overview system.

The Overview Center should utilize the services provided by the various centers such as the United States Public Health Service's Selective Dissemination of Information (SDI) program on pesticides.* Chemical Abstracts' SDI service for the identification of literature on specific hazardous chemicals may be utilized. Review reports and accession lists on computer printouts will round out the Overview Center's surveillance coverage. As specific threat areas are defined, it would be desirable to establish close ties with the appropriate and best centers via incremental funding of areas of principal concern. Privately sponsored centers may be able to provide inputs to specific threat areas; however, they would be of low availability to the wide range of literature coverage of the Overview Center.

Published Literature

The continuous flow of published newsletters, periodicals, and abstract journals which form the communication net for the scientific and technical communities not only offer much scientific information and data useful in preparing threat evaluations but also carry indicators, visible to the expert practitioner, of potentially harmful contaminants in the environment.

As a partial result of the case studies, and also as the result of direct survey, a list of 61 published sources have been identified and listed in Appendix B. As previously indicated, it is the opinion of the investigation team that these publications should be regularly screened by the Information Section of the Overview Center for identification of ALERT A material. Based on actual operational experience, various publications may be added or subtracted from this list. The absence of other publications from this list by no means subtracts from their usefulness both for evaluation and for monitoring. For an embryonic Environmental Health Overview Center, however, this list probably includes the most productive and crucial published sources.

*This is an experimental program currently being developed under Contract PH-86-66-133 with the Office of Pesticides, Communicable Disease Center, U. S. Public Health Service.

Estimation of Information Input

The number of items to be considered and processed into the data bank of the overview system is a major cost determinant. In the proposed system, these input items will be mostly articles from the current technical press or abstracts of such articles gleaned from secondary indexing and abstracting journals which cover the many fields of interest to the overview system. A list of the 61 journals to be covered is given in Appendix B.

As indicated in Figure 5, input into the system is essentially a two-step operation. The first step is for the information specialists to select relevant items from the literature based on the guidelines provided by the scientific evaluators. The scientific evaluators would then screen this material to identify "hot" items, those items pertinent to the Overview Center, or those items which should be discarded.

To arrive at a count of the possible number of relevant items which might be identified by the information specialists, sample counts were made in six of the 38 primary journals, four of the nine newsletters, and two of the 14 abstract journals listed in Appendix B. Relevancy of an article was based on the presence of information defined under Critical Indicators (Table 1) related to chemicals or chemical groups of public-health significance such as those illustrated in Appendix C.

These counts indicated that the typical primary journals would yield 57 items of information per year suitable for input to the overview system. Projected for all 38 primary journals, this would represent an annual total of 2,166 items.

The typical newsletter yielded 91 relevant items per year, or an annual total of 819 items for all 9 newsletters. Allowing for a 10 percent duplication, 737 separate items per year might be expected from this source.

Sampling of the abstract and index journals represented a considerably more complicated task due to the probable high degree of redundancy which exists within such documents. A further complicating factor is that many of the items which would be identified through such secondary sources may be identified earlier through screening of primary source materials.

To arrive at a satisfactory estimate, considerable emphasis was placed upon earlier work by Spencer[1] who had compared the preparation of a comprehensive drug bibliography using several methods and sources. Of concern to this study is the fact that 69 percent of all pertinent literature on the drug of concern was found in two sources: Chemical Abstracts and Index Medicus. Also, she found that 46 percent of the pertinent references in Chemical Abstracts were also found in Index Medicus.

While these ratios probably are not exactly comparable in considering literature that would be of interest to the Overview Center, they are closely allied and represent the best factors available.

On this basis, then, a sample count of recent volumes of Chemical Abstracts and Index Medicus was made:

Relevant articles in Chemical Abstracts	2,080
Relevant articles in Index Medicus	4,410 .

But, according to Spencer[1], 46 percent of references in Chemical Abstracts are also in Index Medicus, which would leave 1,123 unique references in the former.

The total unique references 1,123 + 4,410 = 5,533.

Assuming this represents 69 percent of the total relevant literature, the total would be 8,020.

Thus, in the technical and scientific abstract journals, approximately 8,020 relevant articles would be identified annually. Of these, 2,166 should be identified at an earlier date through current scientific journals and would be duplicated in the abstract publications.

Since newsletters normally are not abstracted nor indexed, another 819 items should be included. Thus, the total number of relevant references which might be located by the information specialists would be of the order of 8,800 citations per year, or slightly over 700 per month.

COST ESTIMATES OF AN ENVIRONMENTAL HEALTH OVERVIEW CENTER

As is evident from the foregoing considerations, the Environmental Health Overview System represents a very complex, many-faceted operation. Throughout the course of this research project, a concentrated effort has been made to accurately estimate those factors by which the costs for operating the center might be estimated.

Because of the diversity and magnitude of the scope and nature of the information necessary to maintain the overview, it has been extremely difficult to derive reliable quantitative figures on all facets of the recommended operation. For example, at this point, it is impossible to determine how many evaluative reports may be required or desired, particularly during the initial phases of evaluation of the environment. It was also impossible to determine the number of "hot leads" that may come to the attention of the scientific evaluators that might require preliminary evaluation.

Estimates have been made of the number of publications that may have to be screened and of the amount that may be useful to the overview. However, even this must be determined by the specific requirements of the individual scientists in the performance of their analytical and evaluative functions.

This condition is not unique for the Overview Center. Similar conditions have existed during the establishment of other such broad-base information analysis centers. Battelle's experience gained in the establishment and operation of various information analysis centers for the Department of Defense, Arms Control and Disarmament Agency, and National Aeronautics and Space Agency has been drawn upon for guides and "rules of thumb" in preparing cost estimates for an operational Environmental Health Overview Center.

Discussion

The general considerations necessary for estimating costs of the Overview Center may be stated as follows:

(1) The number and nature of investigations of apparent threats to the environmental health of the United States which should be made each year.

(2) The amount of information and data which must be reviewed each year to maintain an overview of the environment.

(3) The amount of literature which should be reviewed to maintain an overview of those industrial processes, new products, and by-products which may affect the environmental health of the United States.

(4) The number of scientific and technical inquiries received by the Center.

However, each of the above considerations involves many factors, some of which are measurable, some of which can be estimated, and others which can only be determined through actual operating experiences.

Apparent Threat Evaluation Reports

In establishing an overview system, it is impossible to estimate, in advance, the number of critical situations or possible threats to the environmental health of the United States that may be required during a given year. Many areas are already receiving urgent attention, such as water and stream pollution, pesticides, etc. The five case studies conducted as a part of this design problem each had varying degrees of urgency which dictated their choice. New instances of possible threats to environmental health are in the news frequently.

The five case studies represent detailed evaluations of apparent threats. Referring to Figure 5, such reports would normally be prepared at the second-stage threat-evaluation level and could result in one of three verdicts: (1) no threat, (2) recommend continued surveillance (which would indicate no immediate threat but require close monitoring), or (3) identification of a possible threat (ALERT C).

Obviously, a report carefully evaluating a situation that results in either of the first two decisions is just as important as one detailing an apparent threat. Until all areas of concern have been evaluated, at least once, many news items could lead to the preparation of evaluation reports. Obviously, the number of such reports would have to be controlled by careful and judicious selection of the more critical areas.

The purpose of the feedback loop resulting from the Advisory Reports (ALERT B) to the staff of the United States Public Health Service Environmental Health Overview Office, as shown in Figure 5, is to permit that office to guide the preparation of detailed evaluation reports. In this way, they can take advantage of their broad knowledge of the environment and of their knowledge of research by other organizations to assure that the most urgent areas receive utmost attention.

With these aspects in mind, then, it is this investigation team's recommendation that at full operation, the number of detailed threat-evaluation reports be limited to two per month, or 24 per year. This can be modified on a priority basis. Based on the apparent cost of the five case studies, detailed threat evaluation studies can be accomplished for $10-15,000 each.

Information and Data-Base Activities

The other two considerations, (2) surveillance of the information and data sources to maintain overview of the environment and (3) overview of industrial processes, new products, and by-products which may affect the environment, will be to a large extent based on a review of the current literature including reports, newsletters, and technical journals. (In addition, the scientific evaluators will be able to provide additional surveillance through contacts with their peers, through attendance at technical meetings, and through direct contact with other focal points of environmental health.) The cost of the information and data-base activities will depend on the size of the literature base over which surveillance must be maintained and the amount of literature which then must be incorporated into the data bank.

The current state of the art of information-systems design has evolved to the place wherein it is possible to estimate costs for such systems involving specific, well-defined mission areas.[7,8] Such estimates are based on either a detailed survey of the

literature base of a well-defined narrow and limited subject area or on direct contact and survey of a well-defined research community.

However, in very broad, loosely defined areas, it has not been possible to estimate in advance the size of the data base. In these instances, the actual task assignments to the information analysis center must govern the type and extent of the acquisition program.*

Scientific Inquiries

The fully operational Center, based on the capabilities of its staff of scientist evaluators and the data bank would have the ability to respond to inquiries within its field of coverage. During the initial period of operation, it is recommended that such assistance be provided only to the Public Health Service Overview Office. As the Center matures, the impact of the inquiry answering service on the cost of operating the Center would be continually monitored.

Cost Analysis

Appendix F presents a detailed analysis of the operational and cost factors for the various facets of the Overview Center operation. These represent "best estimates" based on both the qualitative and quantitative criteria developed during this investigation as well as the experience gained from other centers. For convenience and clarity, the costs for each component of the Overview Center are analyzed separately. The components considered are as follows:

(1) Current surveillance

(2) Preliminary evaluation of this information by the scientists

(3) Threat identification

(4) Threat evaluation

(5) Data-bank operations

(6) Project coordination

(7) Consultant coordination.

The cost factors making up each component of the recommended operation are then divided into personnel requirements, materials and supplies, travel, and services and other costs.

Based on the analysis shown in Appendix F it was estimated that 187 man-months of effort per annum would be required to maintain an adequate overview of potential threats to the environmental health. Assigned to the various Overview Center operations, the proportions of the effort would be approximately as follows:

*Examples of centers established in this manner include the Defense Metals Information Center, the Remote Area Conflict Information Center, and the Arms Control Technical Information and Analysis Center.

	Effort, man-months	Percent of Total
• Current surveillance	12	6.4
• Preliminary evaluation	15	8.0
• Threat identification	38	20.3
• Threat evaluation	85	45.5
• Data-Bank operations	13	6.9
• Project coordination	22	11.8
• Consultant coordination	2	1.1

In addition, approximately 4 man-months of consultant effort by experts in environmental health have been allocated. Two man-months of effort to provide coordination of the use of the consultants for threat evaluation and panel activities is also included. This is based on the assumption that most of the expertise required will be available within the organization selected to operate the Overview Center.

Other variables also enter into a final cost estimate for the Center such as the distribution of overhead as computed by various agencies and/or organizations which might be selected to undertake the establishment of an operational center. For convenience, the overhead factors used by Battelle's Columbus Laboratories have been used as representative.

Table 4 summarizes the overall cost estimates for a fully operational center. The total estimated cost, subject to the limitations discussed above, suggests that a fully operational center may cost on the order of $875,000 per annum.

TABLE 4. SUMMARY OF COSTS FOR OPERATING THE ENVIRONMENTAL HEALTH OVERVIEW CENTER

	Cost, dollars
Salaries and Wages	399,000
Materials and Supplies (Includes Consultant Costs)	37,450
Travel	8,600
Other Costs	131,500
Subtotal	576,550
Overhead and Fees Charge	296,815
Total	873,365

Note: The summary costs were derived from separate analyses of costs associated with the seven functions comprising the total operation of the Environmental Health Overview Center. These analyses are shown in detail in Appendix F.

SPACE REQUIREMENTS

If the overview system is operated as an adjunct to a functioning parent organization, rather than as a separate and independent unit, ordinary administrative and housekeeping services, library facilities, computer services, editorial aid, report reproduction, and many other services would be available to such a unit either as normal overhead functions or would be available, as needed, on a use-rate basis. Extra space needs for such supporting services resulting from the operations of the overview system will not be considered in this report. Other system space needs fall into two categories: (1) those needs related to system management operations and the associated full-time staff and (2) those involved with housing the part-time staff of scientific and technical specialists. Management operations should be centralized in a system management center. This would contain working quarters for the management staff, storage space for information files and other equipment, and working space for the specialist staff assigned to the system.

Table 5 presents estimated space requirements for the Overview Center under full operational conditions. The space allocated for 13 professionals includes managerial personnel. The table is based on the man-months of effort shown in Appendix F. The space requirements for the Washington Management Office of the Environmental Health Overview Center are indicated.

TABLE 5. ESTIMATED SPACE REQUIREMENTS FOR ENVIRONMENTAL HEALTH OVERVIEW CENTER

	Space Requirements, sq ft
Overview Management Staff and Operations	
Professionals (100 sq ft per person)	1000
Clerical and Support Staff (75 sq ft per person)	450
Information Files and Equipment	600
Other Work Space (for part-time specialist staff)	300
Total	2350
Washington Management Office	
Professionals	300
Clerical	300
Total	600

RECOMMENDED PILOT OPERATION

To further validate the overview system as described in this report and to gain further insight into the cost factors surrounding a fully operational Overview Center, it is recommended that the United States Public Health Service consider the establisnment of a pilot operation for an 18-month period at one-fourth funding of that estimated for a fully operational center. It is further suggested that the pilot operation be designed to cover in depth several areas (e.g., petro-chemicals, process metallurgy) of primary concern to the United States Public Health Service.

The in-depth pilot operation would involve all of the elements of the fully operation Environmental Health Overview Center:

- Current surveillance
- Preliminary data evaluation
- Threat identification
- Threat evaluation
- Data-bank operation
- Project coordination
- Consultant coordination.

It would also permit further evaluation and resolution of the problems associated with the broad scope and diversity of interest of the center, while at the same time providing tangible services to the United States Public Health Service. The need for the Center to respond to inquiries on environmental health would also be evaluated to determine the magnitude of such an effort.

Battelle recommends this approach because it would immediately place the overview alerting system in operation, if only on a limited scale, and it would yield the necessary statistics to better assess the magnitude of the total operation. An estimated budget for this type of operation is shown in Table 6. Table 7 provides the space requirements for the pilot Overview Center based on the scaled-down man-month requirements given in Appendix F for the fully operational center.

TABLE 6. AN ESTIMATED BUDGET FOR A PILOT OVERVIEW PROGRAM

	Cost, dollars
Salaries and Wages	155,000
Materials and Supplies	11,500
Travel	3,000
Other Costs	50,000
Overhead and Fees	110,500
Total	330,000

TABLE 7. ESTIMATED SPACE REQUIREMENTS FOR A PILOT ENVIRONMENTAL HEALTH OVERVIEW CENTER

	Space Requirements, sq ft
Overview Management Staff and Operations	
Professionals (100 sq ft per person)	300
Clerical and Support Staff (75 sq ft per person)	150
Information Files and Equipment	150
Other Work Space (for part-time specialist staff)	--
Total	600
Washington Management Office	
Professionals	100
Clerical	75
Total	175

REFERENCES

(1) Spencer, Carol C., "Subject Searching with Science Citation Index: Preparation of a Drug Bibliography Using Chemical Abstracts, Index Medicus, and Science Citation Index, 1961 and 1964", American Documentation, 18 (2), 87-96 (April, 1967).

(2) "Deformities Caused by Thalidomide", Rep. Publ. Hlth. Med. Subj., No. 112, H M Stationery Office, London (1964), 70 pp.

(3) McCauley, Margery J., "Abstracting and Extracting Cost", Unpublished paper presented at the 8th Annual Institute on Information Storage and Retrieval, The American University, February 14-17, 1966.

(4) "Medical and Health Related Thesaurus", U.S. Public Health Service, Washington, D C (1963), 213 pp.

(5) Kruzas, Antony T., "Directory of Special Libraries and Information Centers", Gale Research Company, Detroit, Michigan (1963).

(6) "A Directory of Information Resources in the United States – Physical Sciences, Biological Sciences, Engineering", National Referral Center for Science and Technology (January, 1965)

(7) Simons, E M., Lemmon, A. W., Jr., Darby, R L., and Veazie, W. H., Jr., "A Liquid Metals Information Center Scoping Study", U.S. Atomic Energy Commission, BMI-X-261 (September 30, 1963), 33pp + appendix.

(8) "A Study of Requirements for Establishment and Operation of a Transducer Information Center", U.S Air Force, Research and Technology Division, Technical Documentary Report No. FDL-TDR-64-34 (March, 1964), 51 pp + appendixes.

GAL/SBG/JBB/PJM/RLD/WHV:spr

APPENDIX A

SELECTED ENVIRONMENTAL MONITORING SYSTEMS

BATTELLE MEMORIAL INSTITUTE

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APPENDIX A

SELECTED ENVIRONMENTAL MONITORING SYSTEMS

National Air Sampling Networks

In 1953 the Public Health Service set up the National Air Sampling Network (NASN) to measure solid pollutants. The system started with monitoring stations in 17 of the "dirtiest" cities in the country. In 1962, as an increased awareness of the importance of gaseous pollutants began, the Public Health Service initiated the Continuous Air Monitoring Program (CAMP). Six cities were chosen: Chicago, Cincinnati, Detroit, Los Angeles, New Orleans, New York, Philadelphia, San Francisco, and Washington.

Today there are about 225 urban and 35 nonurban stations in the NASN program. These are shown in Figure A-1. Many of these stations are operated by volunteers from state and local agencies using NASN's equipment. One-hundred and seventy-five stations are active in any given year with each state served by at least one sampling station. Some are in operation every year – 80 in large cities and 35 in nonurban sites representing farm, forest, desert, and shore exposures.

Particulate Analyses. Sampling Schedule. Samples of suspended particulate pollutants are taken from the air once every 2 weeks at each operating station. The program yields about 4500 samples per year taken to obtain the maximum amount of information in the most economical way. The suspended particulates are collected with a high-volume air sampler collected usually over a 24-hour period. About 75,000 cubic feet of air is filtered to obtain one sample.

The particulate material is weighed and radioactivity measurements made. Half the material on the filter is used for the extraction of organic constituents (oils and tars) which are subjected to a variety of chemical analyses. Part of the second half of the sample is used for inorganic solids such as nitrates, sulfates, chlorides, and oxides. From another part of the second half of material samples are analyzed for antimony, beryllium, bismuth, cadmium, cobalt, copper, chromium, iron, lead, manganese, molybdenum, nickel, silver, tin, titanium, vanadium, and zinc.

NASN Gas-Sampling Program. Several common gaseous pollutants are now being sampled at more than 50 stations. These samples are collected during a 24-hour sampling period. Currently, nitrogen dioxide, sulfur dioxide, and oxidant are measured. The equipment used for these analyses can collect five gases simultaneously. In nine major urban communities – Chicago, Cincinnati, Detroit, Los Angeles, New Orleans, New York, Philadelphia, San Francisco, and Washington – batteries of automatic instruments have been installed that measure continuously the concentrations of seven gaseous pollutants: sulfur dioxide, nitric oxide, nitrogen dioxide, carbon monoxide, total oxidants, total hydrocarbons, and ozone. These stations also collect particulates and precipitation data and have meteorological instrumentation to record weather conditions.

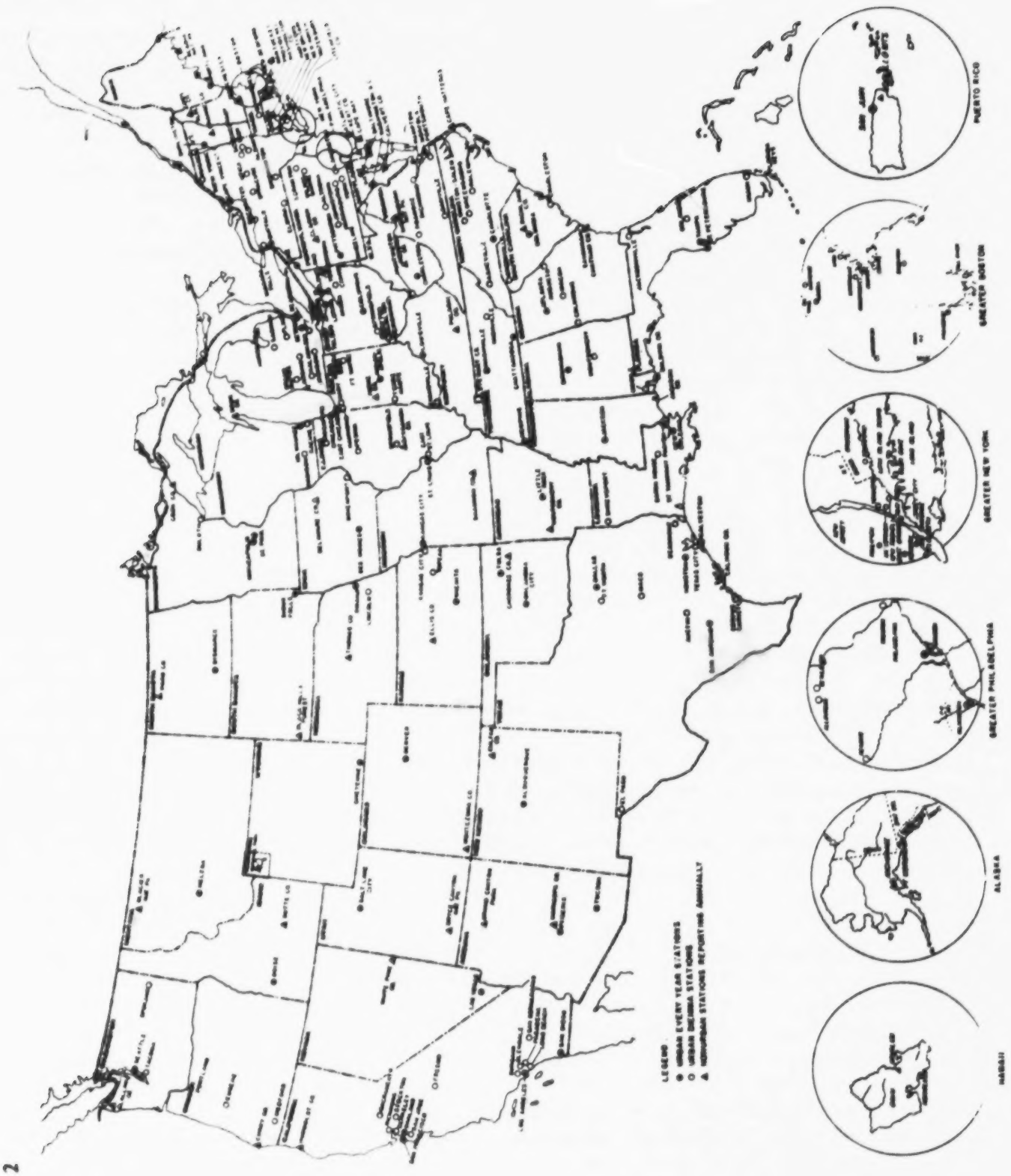


FIGURE A-1. NATIONAL AIR SAMPLING NETWORK

National Water Quality Network

In 1957, the Public Health Service set up some 50 sampling stations to provide information on the quality of the nation's water systems. In 1965 the Network was transferred to the Federal Water Pollution Control Administration (FWPCA) in the Department of the Interior. The program as a whole is designed to assemble, examine, and interpret the facts which enable water-pollution-control agencies and others concerned to determine the scope and character of the problems to be solved.

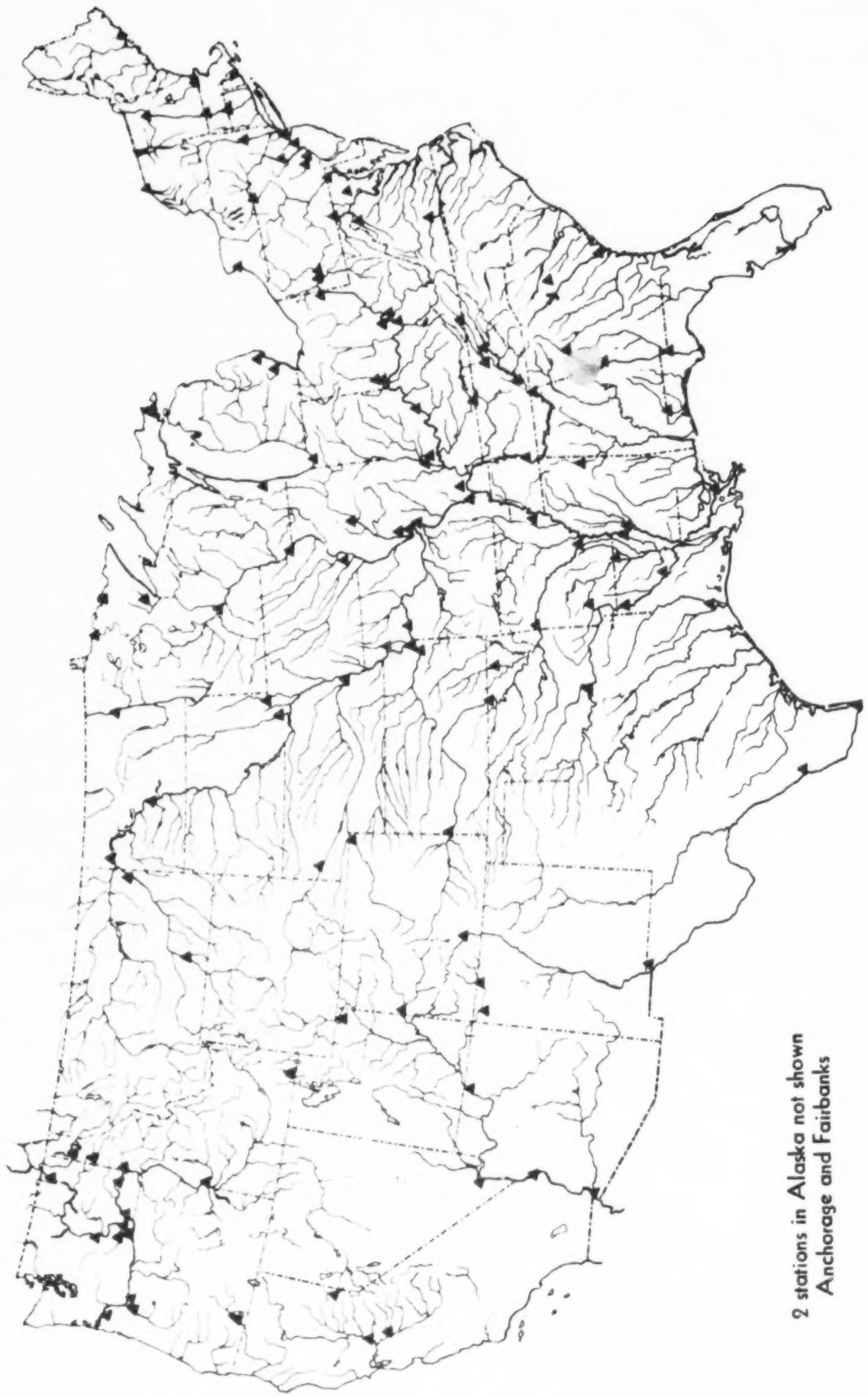
Today the participants in the system include more than 176 state, local and federal water, sewage, or other public utilities, health departments, industries, universities, state water pollution agencies, and resident engineers of federal reservoirs. The state and local agencies perform most of the conventional chemical analyses and collect water samples for the more complex examinations. The FWPCA performs the more complex determinations at its Cincinnati laboratories.

A diagram of the sampling stations is shown in Figure A-2 serving the major river basins shown in Figure A-3. The categories of analyses based on the 1962 report fall into the following groups:

Radioactivity determinations
Plankton populations
Organic chemicals
Chemical, physical, and bacteriological analyses
Flow data
Strontium 90
Trace elements.

The chemical, physical, and bacteriological examinations are made for ammonia, nitrogen, and chlorine demand; color; dissolved oxygen; biochemical and chemical oxygen demands; temperature; alkalinity; pH; hardness; chlorides; sulfates; total dissolved solids; turbidity; and coliform organisms. The organic chemical analyses include analyses of (1) chloroform extracts for ether insolubles, water solubles, weak acids, strong acids, bases, neutrals (aliphatic, aromatic, and oxygenated compounds) and (2) analyses of alcohol extracts. Selected station samples were also analyzed for the trace elements of boron, fluorine, potassium, sodium, selenium, cadmium, beryllium, lead, chromium, tin, antimony, manganese, iron, nickel, bismuth, molybdenum, vanadium, copper, zinc, cobalt, and silver.

Until recently, identification and measurement of most organic compounds in water in parts per billion sensitivity range have required an extremely large sample. Most methods, insofar as they have been developed, are not yet sufficiently sensitive to be of use with smaller samples. A method for measuring from 300 to 5000 gallons, using the absorptive capacity of activated carbon to concentrate organic materials from large water samples, has recently been described by Briedenbach et al. (1966). Using such techniques this report describes methods for the identification and measurement of chlorinated hydrocarbon pesticide in surface waters. Another pesticide monitoring system is carried out by the Agricultural Research Service of the United States Department of Agriculture. This is described (ARS 81-13, December, 1966) in a preliminary report of the studies on soil, sediment, and water in the Mississippi River Delta.



2 stations in Alaska not shown
Anchorage and Fairbanks

FIGURE A-2. PUBLIC HEALTH SERVICE NATIONAL WATER QUALITY NETWORK SAMPLING STATIONS, 1961 - 1962

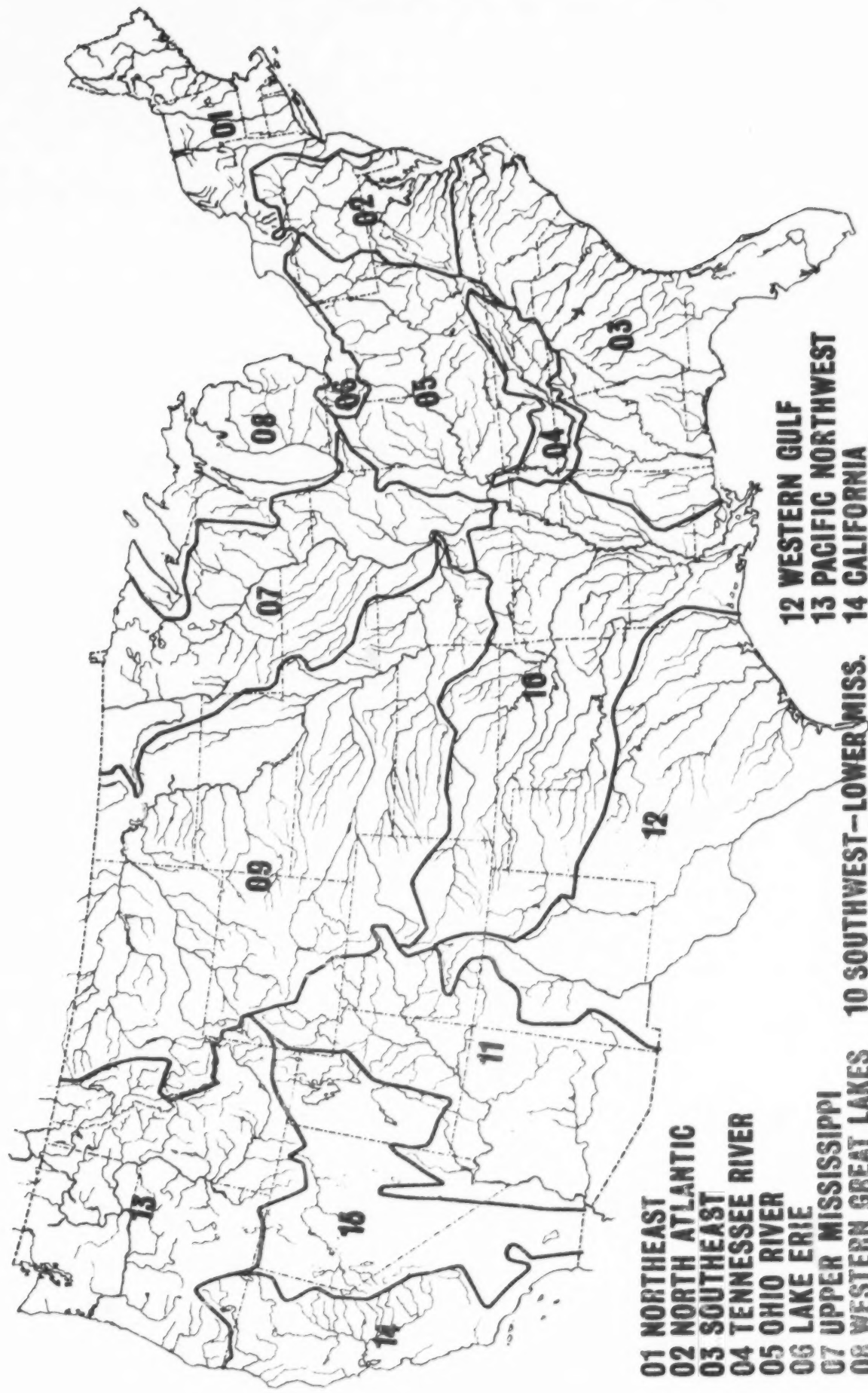


FIGURE A-3. MAJOR RIVER BASINS OF THE UNITED STATES, 1961 - 1962

Ohio River Valley Water Sanitation Commission (ORSANCO)

Aside from the extensive water surveillance system of the FWPCA, ORSANCO's activities in water-pollution control rank higher in the quality of its effort than any other cooperative effort. ORSANCO was formed in 1948 by a cooperative regional pollution-control effort of eight states – Illinois, Indiana, Kentucky, New York, Pennsylvania, Virginia, West Virginia, and Ohio. The ORSANCO district, which embraces portions of these eight states, includes an area of 154,000 square miles and a sewered population of 11,400,000. It is drained by the 981-mile Ohio River and 19 major tributaries.

The network includes 40 sampling locations on the Ohio River and its tributaries which are monitored by the following:

17 locations by managers of municipal and private water-treatment plants, 14 of which are located on the Ohio River main stem; others are on the Allegheny, Monongahela, and New Rivers.

11 under contract with the U. S. Geological Survey, 6 on the Ohio River and the others on tributaries.

12 are served by ORSANCO robot monitoring units. Six of the units are on the Ohio River.

15 are monitored by the University of Louisville.

Analyses made include coliform counts, river flow, dissolved oxygen conditions, conductivity measurements, fluoride, sulfate, chloride, alkalinity, pH, methylene-blue active substances, temperature, iron, manganese, nitrates, threshold odor, and radioactivity.

APPENDIX B

NEWSLETTERS, PERIODICALS, AND OTHER PUBLICATIONS PERTINENT TO THE OVERVIEW PROGRAM

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APPENDIX B

NEWSLETTERS, PERIODICALS, AND OTHER PUBLICATIONS PERTINENT TO THE OVERVIEW PROGRAM

The following publications should be reviewed regularly to obtain information on environmental hazards that are pertinent to the overview system. These publications are identified under seven categories as follows:

Chemistry and Industry

Chemical and Engineering News

Chemical Week

Chemical Engineering

Gaylor's Survey

Search

Bureau of Mines bulletins, circulars, and yearbooks

Modern Plastics

Ceramic Industry

Hydrocarbon Processing

Paper Trade Journal

Chemical Abstracts

Public Health and Epidemiology

Today's Health

Medical World News

New England Journal of Medicine

American Journal Public Health

World Health

United States Public Health Service publications

American Journal of Epidemiology

Public Health and Epidemiology (Continued)

Index Medicus

Biological Abstracts

Public Health Engineering Abstracts

Excerpta Medica – Public Health, Social Medicine and Hygiene

Industrial Hygiene and Occupational Medicine

Occupational Health Newsletter

Environmental Health Letter

Industrial Hygiene Digest

Industrial Hygiene Review

Journal of Occupational Medicine

Archives of Industrial Health

Index Medicus

Biological Abstracts

American Industrial Hygiene

Association abstracts

Air Pollution Control Abstracts

Water Pollution Abstracts

Toxicology

Drug News

Toxicology and Applied Pharmacology

Journal of Pharmacology and Experimental Therapeutics

Food and Cosmetic Toxicology

Archives of Environmental Health

National Clearinghouse for Poison Control Center Bulletins

Toxicology (Continued)

Archives of Industrial Health

Bulletin of Environmental Contamination and Toxicology

Journal of Forensic Sciences

Index Medicus

Chemical Abstracts

Biological Abstracts

Biological and Agricultural Index

Pharmaceutical Abstracts

Industrial Hygiene Digest

International Abstracts of the Biological Sciences

Excerpta Medica – Pharmacology and Toxicology

Environmental Health

Environmental Health Newsletter

Occupational Health Newsletter

Archives of Environmental Health

Environmental Health Research

Bulletin of Environmental Contamination and Toxicology

Index Medicus

Biological Abstracts

Chemical Abstracts

Public Health Engineering Abstracts

Air Pollution Control Association Abstract

Water Pollution Abstracts

Pollution - Air, Water, Waste Control

Air/Water Reports

Environmental Health Newsletter

Water Newsletter

Journal of the Water Pollution Control Association

Air Pollution Foundation Report

Bulletin of Environmental Contamination and Toxicology

Water and Sewage Works

Water Pollution Research

Journal of Sanitary Engineering

Water Resources Research

Biotechnology and Engineering

Environmental Engineering, Quarterly

Air Pollution Control Association Abstracts

Water Pollution Abstracts

Chemical Abstracts

Engineering Index

Applied Science and Technology

Ecology (Animal and Plant Epidemiology)

Ecology

Ecological Monographs

Journal of Ecology

Journal of Animal Ecology

Journal of Applied Ecology

Biological Abstracts

APPENDIX C

LIST OF CHEMICALS IDENTIFIED IN THE SUBJECT INDEXES OF INDUSTRIAL HYGIENE DIGEST, 1964, AND PUBLIC HEALTH ENGINEERING ABSTRACTS, 1965

APPENDIX C

LIST OF CHEMICALS IDENTIFIED IN THE SUBJECT INDEXES OF INDUSTRIAL HYGIENE DIGEST, 1964, AND PUBLIC HEALTH ENGINEERING ABSTRACTS, 1965*

Chemical Feedstocks From Petroleum, Natural Gas, and Coal

acetylene, 1
asphalt, 8
benzene, 15
coal tar pitch, 11
ethylene, 4
isobutylene, 1
naphtha, 1
naphthalene, 1
petroleum distillate, 7
toluene, 1
xylene, 1

Cyclic Chemical Intermediates

aniline, 2
cyclohexanone, 1
cyclohexanol, 1
dichlorophenol, 11
dinitrophenol, 1
ethyl benzene, 1
hexachlorobenzene, 1
isophorone, 1
nitrobenzene, 1
phthalic anhydride, 2
phenol, 21
p-nitrophenol, 1
pyridine, 1
styrene, 1

Dyes

aniline dyes, 3

Flavor and Perfume Materials

methol, 2

Inorganic Chemicals, n.e.c.**

ammonium chloride, 1
ammonium nitrate, 1
boranes (boron hydrides), 1
boric acid, 1
boride dusts, 1
bromine, 2
calcium, 1
carbides, 2
carbon sulfide, 1
carbon dioxide, 9
carbon monoxide, 44
chloride, 1
chlorine, 5
cyanide, 3
fluoride, 23
halogens, 1
hydrogen, 1
hydrogen fluoride, 8
hydrogen peroxide, 2
hydrogen sulfide, 5
iodine, 2
magnesium, 1
nitrates, 4
nitrogen oxides, 33
ozone, 35
phosphoric acid, 4
phosphorus, 2
potassium arsenite, 1
potassium cyanide, 1
selenium, 6
silicic acid, 1
silicon tetrafluoride, 1

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*Each compound or element selected for this list was identified in the literature as being a possible public health threat.
**n.e.c. - "not elsewhere classified".

Inorganic Chemicals (Continued)

- siliceous carbon, 1
- sodium chloride, 2
- sodium cyanide, 1
- sulfates, 8
- sulfides, 2
- sulfur, 5
- sulfur oxides, 94
- sulfuric acid, 5
- super phosphate, 1
- tellurium, 3
- tricalcium phosphate, 1

Medicinal Chemicals

- ammoniated mercury ointment, 1
- amphetamine, 1
- 1, 1, 1-trifluoroethyl vinyl ether, 1
- antibiotic, 16
- arsenitic acid, 1
- dihydrostreptomycin, 2
- griseofulvin, 1
- hormones (in cosmetics), 2
- neomycin, 2
- penicillin, 4
- polymyxin, 1
- salicylate, 3
- streptomycin, 1

Metals (except alkali) and Their Compounds

- aluminum, 6
- aluminum chloride, 2
- aluminum fluoride, 2
- aluminum phosphide, 2
- antimony, 3
- antimony oxide, 1
- arsenic, 3
- arsenicals, 2
- arsenic trioxide, 1
- barium, 1
- beryllium, 29
- cadmium, 5
- cadmium oxide, 1
- chromates, 7
- chromium, 16
- chromium boride, 2
- chromium carbide, 1
- chromium compounds, 1
- cobalt carbide, 1

Metals (except alkali) and Their Compounds (Continued)

- copper, 8
- copper sulfate, 2
- ferrous sulfate, 1
- germanium, 1
- indium, 2
- inorganic arsenicals, 2
- iron, 11
- iron dextran, 1
- iron silicate, 1
- lead, 57
- lead dioxide, 1
- manganese, 4
- manganese dioxide, 2
- mercuric cyanide, 1
- mercury, 23
- molybdenum, 1
- nickel, 16
- nickel carbonyl, 4
- rare earths, 1
- rare earth nitrates, 1
- rare earth oxides, 1
- silver, 1
- tantalum, 1
- thallium, 4
- tin, 1
- trace metals, 4
- trialkylgermanium compounds, 1
- tungsten carbide, 1
- vanadium, 3
- zinc, 12
- zinc beryllium silicate, 2
- zinc sulfate, 1

Nonmetallic Minerals and Fuels

- aliphatic aldehydes, 1
- aromatic hydrocarbons, 19
- aromatics, 1
- artik tuf-lava, 4
- asbestos, 16
- auto exhaust, 12
- cement, 6
- coal and coke, 39
- cryolite, 1
- diesel exhaust, 6
- fiber-glass, 3
- fluorspar, 2
- fuel oil, 2
- gasoline, 7

Nonmetallic Minerals and Fuels (Continued)

glass, 1
hematite, 2
heterocyclic hydrocarbons, 4
hydrocarbons, 28
kaolin, 1
kerosene, 11
mineral oil, 2
nitro-olefins, 5
oil, 2
olefins, 5
paraffins, 1
petroleum, 1
polycyclic hydrocarbons, 1
refinery wastes, 2
silica, 38
solvents, 8
talc, 4

Organic Chemicals, n.e.c.*

acetaldehyde, 2
acetone, 7
acrolein, 11
aerosol propellant, 6
aldehyde, 7
arsine, 2
benz [a] anthracene, 1
benzo(k) fluoranthene, 2
benzotrichloride, 1
benzopyrene, 4
benzpyrene, 4
bithionol, 2
bitumen, 4
2-bromo-chloro-1,1,1,-trifluoroethane, 6
carbazoles, 2
carbon disulfide, 1
carbon tetrachloride, 7
chlorobenzol, 2
chlorobromomethane, 1
chloroform, 1
chlorophose, 1
chloroprene, 2
cosmetic, 1
delta amino-laevulinic acid, 1
1,1-dimethylhydrazine, 2
dimethyldydrazine (UDMH), 3

Organic Chemicals, n.e.c. (Continued)

dimethylsulfoxide, 1
dinitroorthocresol, 1
epoxide, 1
ethyl mercaptan, 3
ethylene glycol, 1
ethylene glycol dinitrate, 1
ethylene oxide, 2
ethylenimine, 2
fluorenthene, 1
fluorocarbons, 2
formaldehyde, 5
freon, 4
fuel additives, 1
furfural, 1
furfuramide, 1
hairspray, 8
hexamethylenediamine, 4
lactone, 1
mercaptans, 2
methane diisocyanate, 1
methane, 1
menthanol, 1
methyl nitrite, 1
methylene-bis-(4 phenylisocyanate), 2
N,N'-di (acetoacetyl)-o-tolidine, 2
neoprene, 1
N-ethylethylenimine, 2
nitroethylene, 1
nitroglycerin, 1
3-nitro-3-hexene, 3
1-nitro-1-propene, 1
pentachlorophenol, 1
peroxyacetal nitrate (PAN), 3
peroxy compounds, 1
petroleum additives, 2
phenylbutazone, 2
phosgene, 3
polytetrafluorethylene, 1
polytrifluorochloroethylene, 1
rocket fuels, 1
simazine, 1
soot, 2
Teflon, 5
tetrachoroethylene, 2
tetraethyl lead, 6
tetramethyl lead, 3
thorotrast, 5
1,1,1-trichloroethane, 2
trichloroethylene, 3

*n.e.c. - "not elsewhere classified".

Organic Chemicals, n.e.c. (Continued)

tridymite, 1
triethyleneglycol, 1
triphenyltin acetate, 1
toluene diisocyanate, 9

Pesticides and Other Organic Agricultural Chemicals

agrosan GN, 2
aldrin, 6
bayluscide, 2
bis-ethylmercury phosphate, 1
chlordane, 2
chlorophenothane DDT (DDE, TDE), 27
coumaphos (Co-Ral), 1
2-4-D, 2
DDVP, 1
dieldrin, 10
dimethoate, 2
endrin, 5
guthion, 4
herbicide, 9
heptachlor expoxide, 4
heptachlor, 2
ICI, 3
insecticide, 22
lindane, 8
malathion, 5
mercury dicyandiamide, 1
molluscicide, 5
NaPCP, 2
organic mercurials, 4
organic phosphate pesticides, 11
organochlorine insecticides, 23
parathion, 12
pesticide, 42
phenyl mercuric acetate, 2
pralidoximes, 1
rogor, 1
sudan, 1
tetraethyl pyrophosphate (TEPP), 2
tetrachlorophenol, 1
thiram, 2

Plasticizers

none

Plastics and Resins

cellulose, 1
plastic, 2
styrene (vinyl benzene), 2

Rubber Processing Chemicals

none

Surface-Active Agents

ABS, 13
detergent, 30
LAS, 13

Synthetic Rubber (Elastomers)

none

APPENDIX D

CENTERS OF INFORMATION OF VALUE TO THE ENVIRONMENTAL HEALTH OVERVIEW CENTER

APPENDIX D

CENTERS OF INFORMATION OF VALUE TO THE ENVIRONMENTAL HEALTH OVERVIEW CENTER

The following centers or sources of information should provide input for the overview system which will enable the system to more completely define environmental hazards and predict potential hazards. They are divided under broad subject areas, some of which appear under more than one heading. They were chosen as representative of the type of centers which have in the past or are presently active in carrying out research or analyzing data from other sources.

Of general interest, but not categorized below are:

(a) Clearinghouse for Federal Scientific and Technical Information (Commerce)

(b) National Referral Center for Science and Technology and the Science Technology Division of the Library of Congress

(c) Science Information Exchange (Smithsonian Institution)

(d) Defense Supply Agency, Defense Documentation Center

(e) National Aeronautics & Space Administration, Division of Scientific and Technical Information

(f) Atomic Energy Commission, Division of Technical Information.

Environmental Health (Human Epidemiology)

(1)	Public Health Service	Overall health analyses and policy administration
(a)	Bureau of Disease Prevention and Environmental Control National centers for: Air Pollution Control Chronic Diseases Communicable Diseases Radiological Health Urban and Industrial Health	Overall health analyses and administration
(b)	National Institutes of Health	Research in diseases
(c)	National Center for Health Statistics	Health statistics analyses
(d)	National Library of Medicine	Health literature
(e)	Public Health Service Library	Health literature and reports

	(f) National Clearinghouse for Poison Control Centers	Toxicity case reports from hospitals
(2)	State and local public health agencies	Collection of health statistics
(3)	Bureau of Labor Statistics	Industrial health data
(4)	Social Security Administration	Social security claim statistics
(5)	Offices of Surgeon Generals of Army, Air Force, Navy, etc.	Military health statistics, toxicity exposure data
(6)	Veterans Administration	Veteran health statistics
(7)	University environmental health programs such as Institute of Environmental Health (University of Michigan)	Occupational safety data
(8)	International Occupational Safety and Health Information Center, Geneva, Switzerland	Occupation health literature
(9)	Insurance company actuarial studies	Population health statistics
(10)	Industrial hygiene associations	
	(a) Industrial Hygiene Foundation of America, Pittsburgh, Pennsylvania	Occupational health
	(b) American Industrial Hygiene Association, Detroit	Occupational health
	(c) Industrial Medical Association, Chicago	Occupational health
(11)	American Medical Association	Environmental and occupational health
(12)	University schools of public health, such as that of the University of Pittsburgh, Michigan, etc.	Occupational health research

Ecology (Epidemiology of Plants and Animals)

(1)	Agricultural Research Service (USDA)	Plant and animal disease control National Animal Disease Laboratory

(2)	National Agricultural Library (USDA)	Information on plants, animals, veterinary medicine, forestry, etc.
(3)	Bureau of Commercial Fisheries (Interior)	Basic and applied studies of biology, ecology of commercially important marine organisms
(4)	Bureau of Sport Fisheries and Wildlife (Interior)	Fish husbandry and management, and conservation and management of wildlife
(5)	National Park Service (Interior)	Conservation of natural flora and fauna
(6)	Bureau of Land Management (Interior)	Range, forest, and wildlife management
(7)	Biological Abstracts, Philadelphia	Ecological literature
(8)	American Forestry Association, Washington, D. C.	Forestry conservation
(9)	National Wildlife Federation, Washington, D. C.	Wildlife conservation
(10)	National Society of Agronomy	Soil and plant ecology
(11)	Other professional agencies	
	(a) Aquatic Research Institute Stockton, California	Aquatic biology
	(b) Battelle Memorial Institute	General ecological information and systems studies

Demography (Population Statistics and Research)

(1)	Bureau of Census (Commerce)	Census of Agriculture Census of Population Current Population Reports Population Trends
(2)	Economic Research Service (Bureau of Census and USDA)	Farm population
(3)	Population Index (Princeton University)	Quarterly reports
(4)	Social Science Research Council, New York City	Census Monograph Series
(5)	Population Research Laboratory (University of California)	Population research
(6)	The Population Council, New York City	Census analyses

Business and Economics

(1)	Bureau of Census (Commerce)	Census of Business Country Business Patterns Enterprise Statistics
(2)	Congressional Subcommittee reports	Various evaluative studies
(3)	Federal Trade Commission	Financial reports
(4)	Internal Revenue Service (Treasury)	Statistical evaluation of income sources
(5)	Office of Business Economics (Commerce)	Survey of current business, business outlook
(6)	President's Economic Reports	Annual reports
(7)	Bureau of Labor Statistics (Labor)	Occupational statistical analyses
(8)	Bureau of Mines (Interior)	Statistics on mining industries
(9)	Agricultural Marketing Service (USDA)	Agriculture business analyses
(10)	Bureau of Employment Security	Employment trends
(11)	Small Business Administration Reports	Business analyses
(12)	Dunn and Bradstreet, New York, and other stock market analysts	Economic trends
(13)	Fortune (Time, Inc.), New York	Economic analyses
(14)	National Bureau of Economics Research, New York	Economic analyses
(15)	Manufacturing Chemists Association Library, Washington, D.C.	Chemical industry analyses
(16)	American Chemical Society	Chemical industry analyses

Pollution Technology

Pollution Control – Air, Water, and/or Solid Wastes.

(1) Various state pollution control agencies such as Los Angeles County Air Pollution Control Board

(2) Chemical Abstracts, Columbus, Ohio – Pollution literature/literature analyses

(3) Battelle Memorial Institute, Columbus – Pollution research/literature analyses

(4) Industrial Hygiene Associations – Literature review

(5) Atomic Energy Commission – Radioactivity fallout and waste disposal technology

(6) Manufacturing Chemists Association

(7) American Society of Sanitary Engineers

(8) Committee on Sanitary Engineering and Environment, NAS/NRC

Air Pollution Control.

(1) National Center for Air Pollution Control (PHS) – Monitoring and research

(2) Air Pollution Control Association

(3) Bay Area Air Pollution Control District

(4) Air Pollution Technical Information Center, University of Pennsylvania

Water Pollution and Solid Waste Management.

(1) Federal Water Pollution Control Administration (Interior) – Monitoring and research

(2) American Water Works Association, New York City

(3) Associated Laboratories, Lothrup Village

(4) National Water Institute, New York City

(5) Water Information Center, Port Washington, New York

(6) Water Pollution Control Federation, Washington, D.C.

Physical Environment (Meterology, Hydrology, Topography, etc.)

(1)	Library of Congress	Literature of general areas
(2)	Environmental Sciences Services (Commerce)	Administration
	(a) Environmental Data Systems	National Weather Records Center- storage, retrieval, analysis of climatological and geophysical data
	(b) Weather Bureau	Observes, reports, and predicts weather on a national and international basis
	(c) Institute of Environmental Research	Integrated research programs relating oceans and inland waters, atmospheric and space environments
	(d) National Environmental Satellite Center	Environmental data from satellite systems
	(e) Coast and Geodetic Survey	Conducts surveys, analyses, and research in hydrography, oceanography, geodesy, etc.
	(f) Office of Scientific Information and Documentation	
	(g) Office of the Federal Coordinator for Meterological Services and Supporting Research	
(3)	Bureau of Census (Commerce)	Area Measurement Reports
	(a) Geological Survey	Topographic maps, geological structures, water supplies – sources, quantity, quality, distribution, movement
	(b) Federal Water Pollution Control Administration	Research and data collection on water resources
(4)	Department of Interior	
(5)	American Geographic Society, New York	World geography, maps of topography and climate, geographical literature
(6)	American Meteorology Society, Boston	Meteorology literature including atmospheric structure, dynamics, chemistry, hydrometry, etc.

(7)	National Center for Atmospheric Research, Boulder, Colorado University of Colorado	High Altitude Observation Library emphasis on fluid envelope and magnetosphere of the earth, astrophysics, etc. NCAR Library-meteorological materials.
(8)	Water Information Center, Port Washington, New York	Water supply, waste disposal, and conservation
(9)	Atomic Energy Commission	Atmospheric fallout studies – air and water research

Toxicology

(1)	National Clearinghouse for Poison Control Centers	Acute toxicity of commercial products and their toxic ingredients
(2)	University of Rochester Toxicology Center	Toxicology of commercial products
(3)	Advisory Center for Toxicology, National Research Council	Industrial toxicology
(4)	National Library of Medicine	Toxicology literature via Index Medicus and MEDLARS computer searches
(5)	Chemical Abstracts	Section on biochemistry includes toxicology and pharmacology
(6)	Biological Abstracts	Includes toxicology literature
(7)	H. Wilson Company, Biological and Agricultural Index	Agricultural-veterinary literature
(8)	Food and Drug Administration	Conducts research and reviews the research of others in the areas of drugs, cosmetics, antibiotics, food additives, and various hazardous substances
(9)	U.S. Department of Agriculture	Publishes Bibliography of Agriculture, maintains a library and the Pesticide Registry and a Pesticide Information Center
(10)	U.S. Army, Biological Laboratory	Biological warfare literature and closed system toxicology
(11)	Industrial Liaison Department U.S Army Chemical Research Laboratories Edgewood Arsenal	Physiological properties of chemical compounds for (1) chemical warfare-agents (2) antiradiation drugs, and (3) antimalarials

(12)	U.S. Treasury Department, Coast Guard	Cooperative effort with NAS/NRC in maintaining a file of hazardous materials important in transportation
(13)	U.S. Veterans Administration	Drug effectiveness and research on psychopharmacological agents

APPENDIX E

VISITATIONS TO INFORMATION CENTERS ON TOXICOLOGY

APPENDIX E

VISITATIONS TO INFORMATION CENTERS ON TOXICOLOGY

To evaluate the various information resources which could be utilized by the Environmental Health Overview Center and to aid in the coverage of toxicology, members of the investigating team visited the principal sources. This appendix provides a brief discussion of these visits. Local contacts were made to broaden the base of the investigating team's knowledge of local resources prior to travel to more distant locations.

The Ohio State University, Columbus, Ohio

The library holdings of the University applicable to environmental health, preventative medicine, occupational medicine, and toxicology were reviewed. A specialized Preventative Medicine Library is available. Information on the Department of Labor, Geneva, Switzerland, International Occupational Safety Health Information Center was obtained. The University Health Center Library would be able to provide valuable inputs for an Environmental Health Overview Center.

Children's Hospital, Poison Control Center, Columbus, Ohio

The Center is one of 500 poison control centers in the United States served by the National Clearing House for Poison Control Centers (see later discussion). Composition of any and all potential ingestants and toxins, toxicity ratings, signs and symptoms of respective toxicities, and treatment methods and procedures are recorded for rapid retrieval.

National Library of Medicine, Bethesda, Maryland

The scope of NLM is all of the basic biomedical and clinical sciences. It is the largest of its kind in the world and in its computerized system has done an outstanding job of providing information on as current a basis as economically feasible. It covers clinical, industrial, and forensic toxicology with major emphasis on basic research relative to clinical importance. It also covers most of what is known in environmental toxicology. It does not generally include reference to government or industrial house-organ publications. NLM provides the biomedical community with Index Medicus, MEDLAR-computer-based searches and more recently its Current Catalogue, Index Medicus covers most extensively the world's medical literature. The Library maintains extensive holdings available to scientists upon request. Journal articles are indexed by descriptors which are fed into the MEDLARS computer system for subsequent literature searches.

Several programs have been developed to improve the NLM toxicology coverage: the Drug Literature Program, which is an effort to improve the descriptor vocabulary for toxicology and the "Auxiliary Chemical Module" which is an integrated effort between NLM, Chemical Abstracts, and the National Science Foundation to combine the resources of the three for better coverage. A third program is a computer-based toxicological information system which is only in its preliminary stages.

Advisory Center on Toxicology, National Academy of Science, Washington, D. C.

This Center contains a large collection of information on industrial toxicology. It is sponsored by the Department of Defense for the several military agencies as well as NASA, AEC, the Coast Guard, and the Public Health Service. It provides advice mainly to Federal agencies and acts as a clearinghouse for published and unpublished toxicological data from the above agencies and the rest of the scientific community. It covers some 40-50 journals, 20,000-40,000 compounds, and 10,000 reprints and has about 175,000 cross-indexed file cards. The Center's staff reviews the open literature and agency reports to recover the information germane to the Center's activities.

Food and Drug Administration, Washington, D. C.

The FDA has laboratories which conduct research and review the research of others in the areas of drugs, cosmetics, antibiotics, food additives, food standards, various hazardous substances, and veterinary products. One study indicated approximately 600 separate sources ("files") of information including open literature, proprietary files, and in-house research reports. The information from these sources is in a variable state of the retrievability.

National Clearinghouse for Poison Control Centers, Arlington, Virginia

The Clearinghouse maintains a current file on commercial products and their toxic ingredients. Their interest is mainly in acute toxicity. They have some 25,000 file cards which list trade names, criteria for diagnosis of poisoning, and treatment measures. The Clearinghouse information is derived mainly from open literature sources, and from company product information. In cases of emergency, proprietary information has been obtained directly from the company making the product or from the confidential files of FDA, USDA, VA, NASA, etc. A relatively new effort at the Clearinghouse is underway in which case reports from hospitals, police files, and FDA are being compiled. This latter effort is an attempt to gain more human toxicological data as opposed to animal data. The Clearinghouse distributes toxicological information to regional centers such as the Children's Hospital, Columbus, Ohio, previously noted.

University of Rochester, Toxicology Center, Rochester, New York

This Center maintains a file of cards similar in scope to the Clearinghouse. The information is derived from the open literature and information sent by manufacturers. The files form the basis of information for the Gleason, Gosslin, and Hodge reference text, Clinical Toxicology of Commercial Products, one of the most broadly extensive coverages on toxicological information under one cover. The book describes briefly the toxic ingredients of the product, the symptoms of poisoning, and type of treatment to be administered. Toxicity ratings are given for the agents on a 1 to 6 scale. Monthly supplements to the book are provided. In addition to a product file, there are also maintained a subject index and a manufacturers' file.

University of Cincinnati, Kettering Laboratory, Cincinnati, Ohio

The Kettering Laboratory investigates problems of industrial and public health brought to it by industry and government. Since the literature in the field of environmental health is subject to controversy and misrepresentation, emphasis is placed on the quality of the abstracts rather than on rapid retrieval of information. The abstracts are concise and critical in an attempt to help the scientists for whom they are intended decide whether or not they wish to consult the original article. The Kettering Laboratory provides specialized information services such as Fluorine Abstracts and Lead Abstracts.

U.S. Public Health Service, Division of Occupational Health, Cincinnati, Ohio

The bibliographic effort is tied in with the International Occupational Safety Health Information Center. The Division of Occupational Health collects both published and unpublished information on all technical aspects of occupational health. Abstracts are prepared for these inputs to their storage and announcement system.

APPENDIX F

COST ANALYSES FOR THE FUNCTIONS ASSOCIATED WITH THE ENVIRONMENTAL HEALTH OVERVIEW CENTER

BATTELLE MEMORIAL INSTITUTE

APPENDIX F

COST ANALYSES FOR THE FUNCTIONS ASSOCIATED WITH THE ENVIRONMENTAL HEALTH OVERVIEW CENTER

The cost values shown in the following tables were derived by fairly detailed analyses of the specific costs associated with the various functions which, collectively, make up the overview system. Initial estimates were based on selected cost ranges for each anticipated function and specific estimates of materials, supplies, and services of various kinds. The bases for quantities and grades applicable to each estimate were derived from either the experience gained in the case studies on mercury, nickel, etc. or from Battelle's general experience in establishing and operating several information analysis centers. Final values used in the following tables have been rounded to more easily comprehended numbers. An effort has been made, also, to consider rate structures and accounting procedures of various organizations which might be selected as parent organization for the Overview Center. The expressed values, however, are probably most applicable to Battelle conditions. For this reason and due to the considerable variability and uncertainty inherent in such estimates, the cost values presented should be considered only as one possible set of costs within a range of several such sets depending upon the organization operating the center and the actual events occurring during the period of estimate.

TABLE F-1. ESTIMATED COSTS FOR THE VARIOUS FUNCTIONS WHICH COMPRISE THE TOTAL ENVIRONMENTAL HEALTH OVERVIEW CENTER OPERATION

(a) Current surveillance of information and data flow screening of documents, journals, books, etc. necessary for both routine and special coverage of information of interest to the overview system utilizing scientist evaluators and information specialists	
(1) Salaries and wages Professional staff, 12 man-months; clerical staff, 28 man-months	33,000
(2) Materials and supplies	10,000
(3) Travel Trips to secure information and data from specialized information and data centers	1,000
(4) Other costs Laboratory costs, reports services, use-rate charges, and miscellaneous service charges	11,000

TABLE F-1. (Continued)

(b)	Preliminary evaluation – scientist evaluators A vital preliminary evaluation of current information and data by a core group of key scientific specialists to identify new developments in chemical technology; industrial, agricultural, and consumer applications which may pose a threat to the public health	
	(1) Salaries and wages Professional staff, 15 man-months; clerical staff, 15 man-months	36,000
	(2) Materials and supplies	250
	(3) Travel Trips to conferences and seminars, for consultation, and to collect unpublished data and information	1,500
	(4) Other costs	10,000
(c)	Data Bank operations Processing, storage, and retrieval of information required to support scientific evaluation and threat identification. Based upon preliminary selection and screening of an estimated 8,800 items per year, 40 percent of which will be processed for the Data Bank utilizing information specialists	
	(1) Salaries and wages Professional staff, 13 man-months; clerical staff, 28 man-months	33,000
	(2) Materials and supplies	4,500
	(3) Travel	900
	(4) Other costs	18,000
(d)	Threat identification Review of information items to identify possible threats to environmental health, 300-400 per year utilizing scientist evaluators, plus related information support	
	(1) Salaries and wages	70,000
	(2) Materials and supplies	400
	(3) Travel	--
	(4) Other costs	18,500

TABLE F-1. (Continued)

(e)	Threat evaluation Analysis and evaluation by scientist evaluators of all available information on possible threats to determine if a threat exists, the nature of the threat, and its magnitude; 1-3 per month, includes related information support	
	(1) Salaries and wages Professional staff, 85 man-months; clerical staff, 20 man-months	160,000
	(2) Materials and supplies	1,000
	(3) Travel	1,200
	(4) Other costs	55,000
(f)	Consultant coordination Advisory panels convened periodically to secure representative opinion on environmental health threats from the scientific community; other consultation as required	
	(1) Salaries and wages Professional staff, 2 man-months*; clerical staff, 6 man-months	7,000
	(2) Consultant costs (estimated to be 4 man-months of effort)	21,000
	(3) Travel	3,000
	(4) Other costs	3,000
(g)	Project coordination Program management and administration, fiscal and quality control, and liaison with program monitor	
	(1) Salaries and wages Professional staff, 22 man-months; clerical staff, 22 man-months	60,000
	(2) Materials and supplies	300
	(3) Travel	1,000
	(4) Other costs	16,000

*Coordination time of Overview Center Staff in management of consultant activities.

APPENDIX G

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